

Prepared for:
Basin Electric, Inc.
South Dakota



Basin NextGen Project

Ambient Air Quality and Meteorological Monitoring Program

Summary Data Report

April 2007 through June 2008

ENSR Corporation
September 2008
Document No.: 02450-017-701

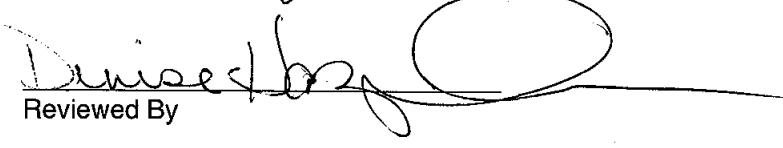
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Prepared By


Reviewed By

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EXECUTIVE SUMMARY

This report provides a summary of the air quality and meteorological monitoring data collected at the Basin NextGen monitoring site near Gettysburg, South Dakota, during the 15-month period of April 2007 through June 2008. The ambient air quality data measured during this 15-month period were well below the National Ambient Air Quality Standards (NAAQS). Data recovery for each individual air quality parameter was above the Prevention of Significant Deterioration requirement of 80 percent for the quarter. The 15-month air quality data for the monitoring site are summarized below.

Federal air quality standards require that the 4th highest 8-hour ozone (O_3) average over the course of data collection (or 3 years) be calculated and reported. That value, based on data starting April 5, 2007 and running through June 30, 2008, is 57.6 parts per billion (ppb) (113.0 micrograms per cubic meter [$\mu\text{g}/\text{m}^3$]) occurring on May 1, 2008.

Parameter	Measured Concentration		Standards NAAQS	
	$\mu\text{g}/\text{m}^3$	ppb	$\mu\text{g}/\text{m}^3$	ppb
NO_2				
1-hour Maximum	18.6	9.9	NS ¹	NS
15-month Average	3.2	1.7	100 ²	53 ²
O_3				
1-hour Maximum	130.3	66.4	236	120
8-hour Maximum	120.3	61.3	157	80
4 th Highest 8-hour Average	113.0	57.6	157	80
SO_2				
1-hour Maximum	12.3	4.7	NS	NS
3-hour Maximum	9.9	3.8	1,300	500
24-hour Maximum	6.5	2.5	365	140
15-month Average	2.1	0.8	80 ²	30 ²
PM_{10} ⁴				
24-hour Maximum	36.8	NA ³	150	NA
15-month Average	13.5	NA		NA
$\text{PM}_{2.5}$				
24-hour Maximum	25.2	NA	35	NA
15-month Average	5.8	NA	15	NA

¹ NS = No Standard.

² 15-month average concentrations are compared to annual NAAQS.

³ NA = Not Applicable.

⁴ PM_{10} values are based upon primary sampler.

NO_2 = nitrogen dioxide.

SO_2 = sulfur dioxide.

PM_{10} = particulate matter with an aerodynamic diameter of 10 microns or less.

$\text{PM}_{2.5}$ = particulate matter with an aerodynamic diameter of 2.5 microns or less.

NAAQS Standards ($\mu\text{g}/\text{m}^3$)

	PM_{10}	$\text{PM}_{2.5}$	NO_2	SO_2		CO	O_3
Annual Average		15	100		80		
1-hour						40,000	
3-hour				1,300			
8-hour						10,000	157
24-hour	150	35		365			
ppb to $\mu\text{g}/\text{m}^3$			1.88	2.62	2.62		1.96
ppm to $\mu\text{g}/\text{m}^3$						1,150	1,150

CO = carbon monoxide.

ppm = parts per million.

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1.0 Introduction

Basin Electric, Inc. (Basin) is the owner and operator of the proposed Basin NextGen Project located in central South Dakota. In support of the planned construction and installation of power plant sources, including coal-fired boilers, Basin has retained ENSR Corporation (ENSR) to install and operate an ambient air quality and meteorological monitoring station near the proposed project location. The primary objectives of this monitoring study are:

- To fulfill pre-construction air monitoring potentially required under Prevention of Significant Deterioration (PSD) permitting rules at the site of the proposed source;
- To obtain baseline ambient air quality concentrations; and
- To provide a comprehensive on-site database for use in dispersion modeling using AERMOD.

To meet these objectives, a meteorological and air quality monitoring station, equipped with a 100-meter (m) tower was established at the Basin site. The station monitors the following parameters:

- Nitrogen oxides (NO_2 , NO, NO_x);
- Sulfur dioxide (SO_2);
- Ozone (O_3);
- Inhalable particulate matter, with an aerodynamic diameter of 10 micrograms or less (PM_{10});
- Inhalable fine particulate matter, with an aerodynamic diameter of 2.5 micrograms or less ($\text{PM}_{2.5}$);
- Barometric pressure;
- 100-m wind speed, wind direction, vertical wind speed, wind direction standard deviation (Sigma-Theta), vertical wind speed standard deviation (Sigma-W);
- 50-m wind speed, wind direction, vertical wind speed, wind direction standard deviation (Sigma-Theta), vertical wind speed standard deviation (Sigma-W);
- 10-m wind speed, wind direction, vertical wind speed, wind direction standard deviation (Sigma-Theta), vertical wind speed standard deviation (Sigma-W);
- 2-m temperature, 10-m temperature, 50-m temperature, 100-m temperature; and
- Precipitation, relative humidity, and solar radiation.

Table 1-1 summarizes the monitoring equipment and measurement methods currently in use at the Basin site. The monitoring system, source environment, sampling frequency, quality assurance program, and data management aspects of the monitoring program are described in the monitoring plan.

This report provides summaries of the data collected for April 2007 through June 2008. A chronology of project progress and significant events during the quarter is presented in Chapter 2.0. Chapter 3.0 contains a summary of network performance and data retrieval statistics. Chapter 4.0 contains a summary of the air quality data recorded during the period. The meteorological data are presented and discussed in Chapter 5.0.

Table 1-1 Ambient Monitoring Program Equipment and Measurement Methods

Parameter	Manufacturer/Model	Sample Frequency	Range	Method
NO _x , NO ₂ , NO (~4m)	Thermo Electron Corporation (Thermo) Model 42C	Continuous	0.001 to 0.500 ppm	Chemiluminescent single chamber
O ₃ (~4m)	Thermo Model 49C	Continuous	0.002 to 0.500 ppm	Ultraviolet absorption
SO ₂ (~4m)	Thermo Model 43C	Continuous	0.001 to 0.500 ppm	Pulsed fluorescent
PM ₁₀ (~4m)	Tisch TE-6070V volumetric Flow Controlled PM ₁₀ monitor	Every 6 days	2 to 750 µg/m ³	10 µm size select inlet, high volume filter sample, gravimetric analysis
PM _{2.5}	Met One Model 1020 BAM	Continuous		Very sharp cutoff cyclone (FEM)
Multi-gas calibrator	Thermo Model 146C	NA	0 to 100 cc 0 to 10 lpm	Mass flow meters
Ozone Transfer Standard	Thermo Model 49C TS	NA	0.001 to 0.500 ppm	Pulsed fluorescent
Horizontal wind speed 10m, 50m, -100m	Climatronics Model F460	Continuous	0.1 to 100 mph	Cup Anemometer/Photo-chopper
Horizontal wind direction 10m, 50m, -100m	Climatronics Model F460	Continuous	0° to 360°	Vane/Potentiometer
Sigma-theta 10m, 50m, -100m	Campbell Scientific CR23X Datalogger	Continuous	0° to 100°	Digital computation
Vertical Wind Speed 10m, 50m, -100m	Climatronics Model 102236-G0	Continuous	-12.5 to +12.5 mph	Propeller Anemometer
Sigma w 10m, 50m, -100m	Campbell Scientific CR23X Datalogger	Continuous	0° to 100°	Digital computation
Temperature 2m, 10m, 50m, -100m	Climatronics Model 100093	Continuous	-30°C to 50°C	Aspirated triple-element thermistor
Temperature Difference (10m-2m, 50m-2m, 100m-2m)	Climatronics Model 100093	Continuous	-5° to 10°	Aspirated triple-element thermistor
Solar Radiation (~4m)	Kipp & Zonen Model CMP3	Continuous	0 to 2 langley/min	Thermopile
Precipitation (~4m)	Climatronics Model 100097-1-G0	Event, 1-hour Accumulation	0.01 in to Unlimited	Tipping Bucket
Relative Humidity (2m)	Campbell Scientific, Model HMP 45C-L	Continuous	0 to 100 percent	Hygrometer
Barometric Pressure (~4m)	Climatronics Model 102663-G0-10	Continuous	600 – 1,100 hPascals	Solid State Piezoresistors
Data logger	Campbell Scientific CR23X	1/second	0-1 v	Digital computer

ppm = parts per million

µg/m³ = micrograms per cubic meter

µm = micrometers

cc = cubic centimeters

lpm = liters per minute

mph = miles per hour

°C = degrees Celsius

v = volts

2.0 Project Progress and Significant Events

Program activities during these 15 months were primarily associated with routine operation, maintenance, and calibration checks. The on-site technician visited the station weekly to change PM₁₀ filters and to check on air quality instruments. Data management included collection, processing, and validation of data.

The calibrations for both meteorological and air quality instruments were reported and submitted on a quarterly basis.

The audits for this site were done by ARS on a quarterly basis and all parameters were within U.S. Environmental Protection Agency (USEPA) specifications.

3.0 Network Performance Summary

The data retrieval statistics for each air quality and meteorological parameter are presented in this chapter along with a brief summary of missing data. Program goals for data capture, as specified by PSD requirements, call for valid data retrieval of 80 percent for air quality parameters on a quarterly basis and 90 percent for meteorological parameters on an annual or 12-month basis.

3.1 Network Data Capture

Continuous air quality and meteorological data capture percentages have been calculated on the basis of the total number of hours of ambient data collected versus the total number of hours in the month. Hours lost to equipment failure, power outage, routine maintenance, calibrations and audits, as well as hours that do not satisfy program goals for accuracy and resolution have been deleted from the dataset in the data validation process. Particulate data percentages have been calculated based on the number of samples collected versus the total number of sampling days.

The data capture rate for each individual air quality parameter was above the PSD requirement of 80 percent for the quarter. The data capture rate for each meteorological parameter was above the PSD requirement for 90 percent annual data recovery.

3.2 Station Performance

Summaries of the data capture performance for the full monitoring period for each parameter are presented in **Table 3-1**.

Table 3-1 Data Recovery by Parameter

Channel	Possible Hours	Valid Hours	Percent Recovery
10 WS	10968	10314	94.0%
10 WD	10968	10371	94.6%
10 ST	10968	10371	94.6%
50 WS	10968	10371	94.6%
50 WD	10968	10152	92.6%
50 ST	10968	10152	92.6%
100 WS	10968	10326	94.1%
100 WD	10968	10371	94.6%
100 ST	10968	10371	94.6%
10 VWS	10968	10438	95.2%
50 VWS	10968	10396	94.8%
100 VWS	10968	10274	93.7%
10 SW	10968	10438	95.2%
50 SW	10968	10396	94.8%
100 SW	10968	10274	93.7%
2 mt	10968	10806	98.5%
10 mt	10968	10430	95.1%
50 mt	10968	10418	95.0%
100 mt	10968	10429	95.1%
10-2 dt	10968	10426	95.1%
50-10 dt	10968	10411	94.9%
100-50 dt	10968	10410	94.9%
RH percent	10968	10833	98.8%
Sol w/m ²	10968	10816	98.8%
Precip.	10968	10835	98.8%
Pressure	10968	10841	98.8%
SO ₂	10968	9976	91.0%
NO	10968	10050	91.6%
NO _x	10968	10140	92.5%
NO ₂	10968	10050	91.6%
O ³	10968	10133	92.4%
Stn T	10968	10813	98.6%
PM ₁₀ *	76	76	100.0%
PM _{2.5} *	8489	8196	96.5%

PM₁₀ and PM_{2.5} recovery values are based on the Primary sampler.

4.0 Air Quality Data Summary

This chapter provides a summary of the air quality data collected for the Basin NextGen monitoring network for April 2007 through June 2008.

4.1 Continuous Air Quality Data

A summary of the air quality data, including a comparison of the data to the applicable federal and state ambient air quality standards, is presented in **Tables 4-1** and **4-2**. More detailed data summaries for each parameter are provided below.

Table 4-1 Basin NextGen Continuous Air Quality Monitoring Data Summary

Parameter		15-Month Average	
		µg/m ³	ppb
NO ₂	Average	3.2	1.7
	1-hour Maximum	18.6	9.9
SO ₂	Average	2.1	0.8
	1-hour Maximum	12.3	4.7
O ₃	3-hour Maximum	9.9	3.8
	24-hour Maximum	6.5	2.5
O ₃	Average	60.5	30.8
	1-hour Maximum	130.3	66.4
	8-hour Maximum	120.3	61.3

ppb = parts per billion.

NAAQS Standards (µg/m ³)							
	PM ₁₀	PM _{2.5}	NO ₂	SO ₂		CO	O ₃
Annual Average		15	100		80		
1-hour						40,000	
3-hour				1,300			
8-hour						10,000	157
24-hour	150	35		365			
ppb to µg/m ³			1.88	2.62	2.62	2.62	1.96
ppm to µg/m ³						1,150	1,150

NAAQS = National Ambient Air Quality Standards.

The 8-hour O₃ standard is being revised to 75 ppb (147 µg/m³) and the monitored data indicate compliance with this standard.

Table 4-2 Comparison of Basin NextGen – Air Quality Monitoring Data to NAAQS
April 2007 through June 2008

Parameter	Measured Concentration Basin NextGen – Gettysberg, SD		Standards NAAQS¹	
	µg/m³	ppb	µg/m³	ppb
NO ₂				
1-hour Maximum	18.6	9.9	NS ²	NS
15 month average ³	3.2	1.7	100	53
O ₃				
1-hour Maximum	130.3	66.4	236	120
8-hour Maximum	120.3	61.3	157	80
4 th Highest 8-hour Average	113.0	57.6	157	80
SO ₂				
1-hour Maximum	12.3	4.7	NS	NS
3-hour Maximum	9.9	3.8	1,300	500
24-hour Maximum	6.5	2.5	365	140
15 month average ³	2.1	0.8	80 ³	30 ³
PM ₁₀				
24-hour Maximum	36.8	NA ³	150	NA
15 month average ³	13.5	NA		NA
PM _{2.5}				
24-hour Maximum	25.2	NA ³	35	NA
12 month average	5.8	NA	15	NA

¹NAAQS are equivalent to state standard.

²NS = No Standard.

³15-month average concentrations are compared to annual NAAQS.

⁴NA = Not Applicable.

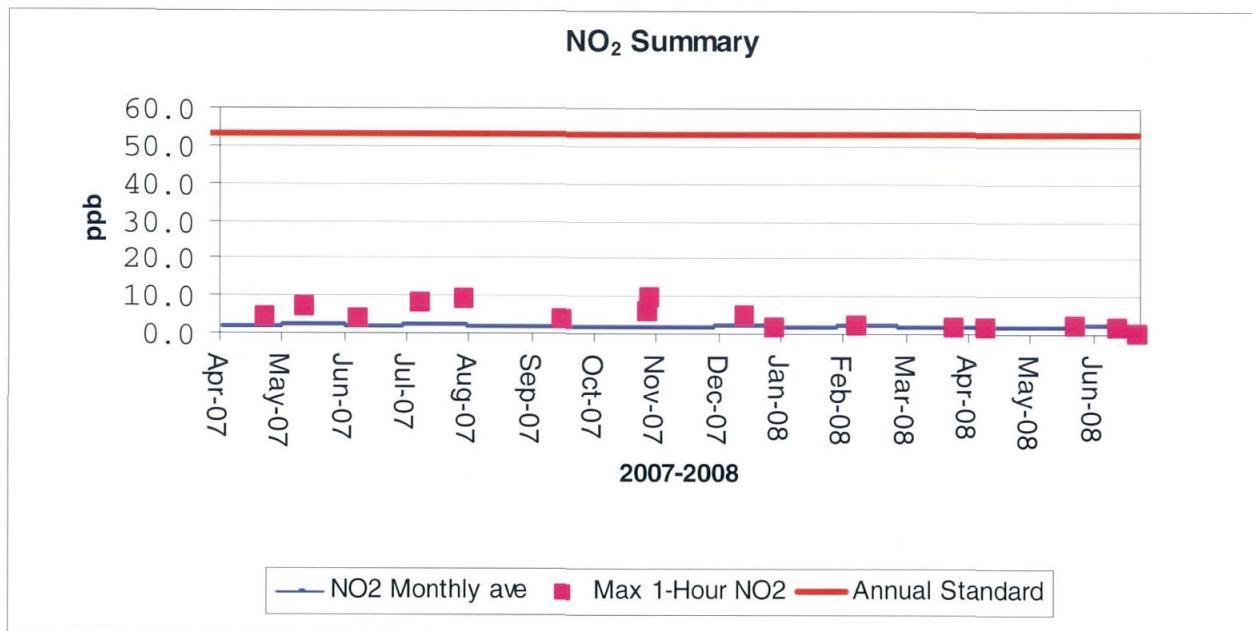
PM₁₀ values are based upon primary sampler.

PM_{2.5} = particulate matter with an aerodynamic diameter of 10 microns or less. Monitored from July 2007 to July 2008.

NAAQS Standards (µg/m³)								
	PM₁₀	PM_{2.5}	NO₂	SO₂		CO		O₃
Annual Average			100		80			
1-hour					40,000			
3-hour				1,300				
8-hour							10,000	157
24-hour	150	35			365			
ppb to µg/m ³			1.88	2.62	2.62	2.62		1.96
ppm to µg/m ³							1,150	1,150

Table 4-3 NO₂ Summary

	NO ₂ Monthly Average ppb	NO ₂ 1-Hour Max ppb	Date 1-Hour Max Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	1.8	0.5	1/4/00	564	720	78.3%
May-07	2.0	6.8	5/14/07	703	744	94.5%
Jun-07	1.4	3.5	6/9/07	660	720	91.7%
Jul-07	1.9	8.2	7/10/07	624	744	83.9%
Aug-07	1.7	9.0	8/1/07	696	744	93.5%
Sep-07	1.5	3.9	9/18/07	661	720	91.8%
Oct-07	1.6	5.7	10/31/07	702	744	94.4%
Nov-07	1.7	9.8	11/01/07	677	720	94.0%
Dec-07	2.0	5.0	12/18/07	677	744	91.0%
Jan-08	1.6	7.3	1/1/08	703	744	94.5%
Feb-08	1.9	5.8	2/12/08	659	696	94.7%
Mar-08	1.4	9.9	3/31/08	690	744	92.7%
Apr-08	1.5	4.5	4/16/08	661	720	91.8%
May-08	1.9	6.7	5/30/08	702	744	94.4%
Jun-08	1.6	9.5	6/20/08	671	720	93.2%
15 month Avg.	1.7	9.9	03/31/08	10050	10968	91.6%
15 month Avg.	3.2	μg/m ³				

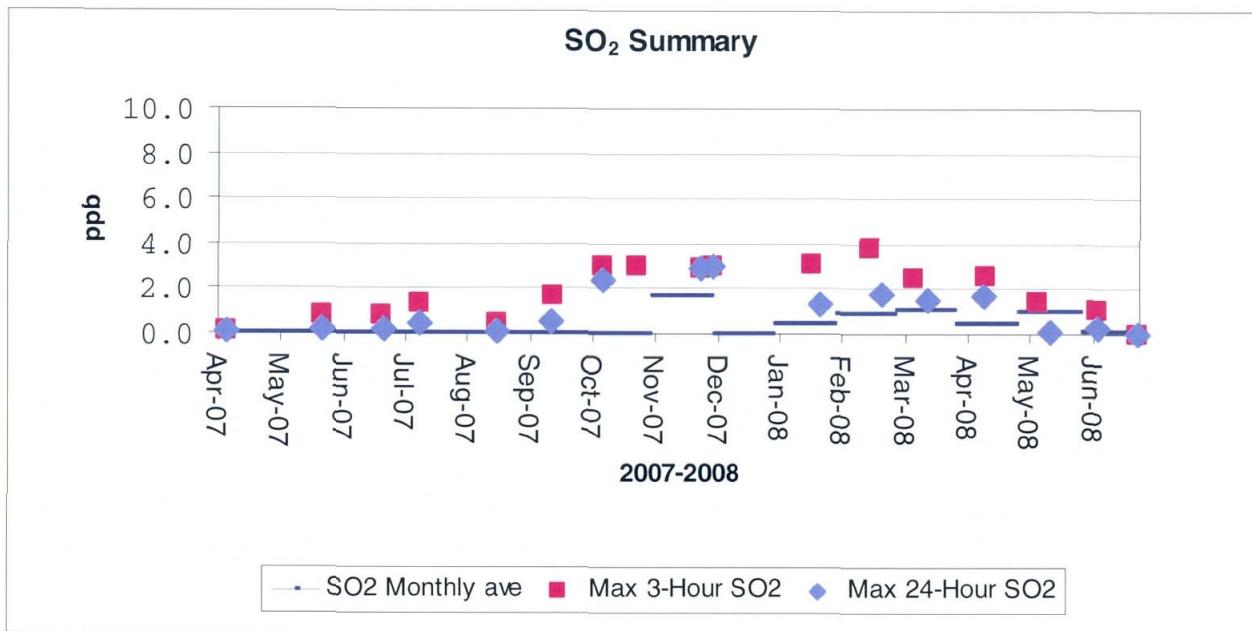
**Figure 4-1 NO₂ Summary**

NAAQS standards for NO₂ are: 53 ppb (~100 μg/m³) annual average.

Note: ppb NO₂ to μg/m³ conversion = 1.88.

Table 4-4 SO₂ Summary

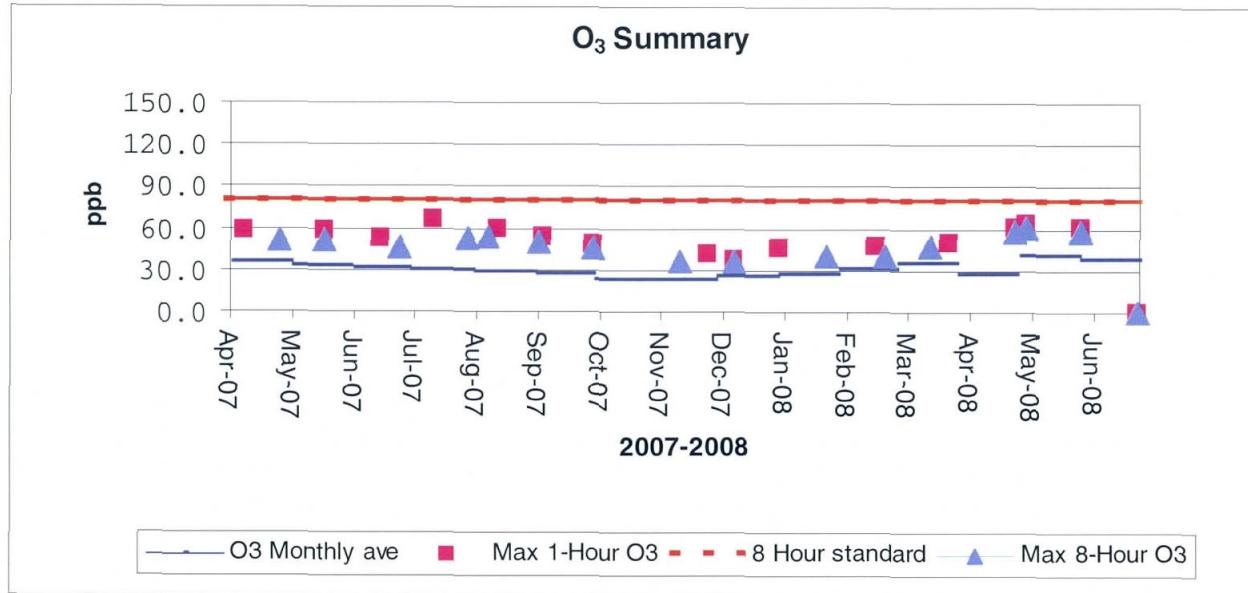
	SO ₂ Monthly Average ppb	SO ₂ 1-Hour Max ppb	Date 1-Hour Max Occurred	SO ₂ 3-Hour Max ppb	SO ₂ 24-hour Max ppb	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	<1	<1	4/5/07	<1	<1	564	720	78.3%
May-07	<1	1.4	5/22/07	<1	<1	703	744	94.5%
Jun-07	<1	2.2	6/21/07	<1	<1	660	820	91.7%
Jul-07	<1	2.4	7/10/07	1.3	<1	624	744	83.9%
Aug-07	<1	1.1	8/17/07	<1	<1	696	744	93.5%
Sep-07	<1	1.8	9/14/07	1.7	<1	661	720	91.8%
Oct-07	<1	3.0	10/09/07	2.4	1.3	702	744	94.4%
Nov-07	1.7	3.0	11/26/07	2.9	2.4	677	720	94.0%
Dec-07	<1	3.0	12/02/07	3.0	2.5	677	744	91.0%
Jan-08	0.4	4.7	1/21/08	3.1	1.3	638	744	85.8%
Feb-08	0.9	4.3	2/18/08	3.8	1.8	659	696	94.7%
Mar-08	1.1	3.3	3/11/08	2.5	1.5	683	744	91.8%
Apr-08	1.0	2.7	4/16/08	2.6	1.7	661	720	91.8%
May-08	0.1	2.4	5/12/08	1.4	0.1	700	744	94.1%
Jun-08	0.1	1.7	6/10/08	1.1	0.3	671	720	93.2%
15 month Avg.	0.8	4.7	01/21/08	3.8	2.5	9976	10968	91.0%
15 month Avg.	2.0	μg/m ³						

**Figure 4-2 SO₂ Summary**

NAAQS standards for SO₂ are: 139 ppb (365 μg/m³) 24-hour average and 30 ppb (80 μg/m³) annual average.
Note: ppb SO₂ to μg/m³ conversion = 2.62.

Table 4-5 O₃ Summary

	O ₃ Monthly Average ppb	O ₃ 1-Hour Max ppb	Date 1-Hour Max Occurred	O ₃ 8-Hour Max ppb	Date 8-Hour Max Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	35.5	57.9	4/8/07	51.7	4/26/07	570	720	79.2%
May-07	32.4	58.4	5/18/07	51.7	5/18/07	708	744	95.2%
Jun-07	30.8	52.3	6/16/07	46.0	6/25/07	665	720	92.4%
Jul-07	30.1	66.4	7/12/07	53.3	7/29/07	658	744	88.4%
Aug-07	27.9	59.8	8/13/07	54.3	8/9/07	705	744	94.8%
Sep-07	27.4	54.7	9/5/07	50.3	9/3/07	684	720	95.0%
Oct-07	23.0	49.2	10/01/07	45.5	10/01/07	708	744	95.2%
Nov-07	23.3	42.3	11/27/07	37.2	11/13/07	685	720	95.1%
Dec-07	25.4	38.0	12/11/07	36.7	12/11/07	698	744	93.8%
Jan-08	27.0	46.6	01/02/08	40.6	01/26/08	643	744	86.4%
Feb-08	30.7	47.9	02/20/08	40.9	02/24/08	663	696	95.3%
Mar-08	34.9	49.9	03/27/08	47.2	03/18/08	693	744	93.1%
Apr-08	41.2	60.8	04/30/08	57.6	04/30/08	668	720	92.8%
May-08	37.3	63.6	05/05/08	61.3	05/05/08	708	744	95.2%
Jun-08	35.5	61.0	06/01/08	57.6	06/01/08	677	720	94.0%
15 month Avg.	30.8	66.4	07/12/07	61.3	05/05/08	10133	10968	92.4%
15 month Avg.	59.6	μg/m ³						

**Figure 4-3 O₃ Summary**

NAAQS standards for O₃ are: 120 ppb (235 μg/m³) 1-hour standard and 80 ppb (157 μg/m³) 8-hour standard
Note: ppb O₃ to μg/m³ conversion = 1.96.

4.1.1 Continuous Analyzer Precision Statistics

Continuous Analyzer Precision Statistics were submitted and presented in each of the five quarterly reports.

4.1.2 Continuous Analyzer Accuracy Statistics

Continuous Analyzer Accuracy Statics were compiled during quarterly independent audits by ARS. Accuracy statistics by quarter can be viewed in each of the five quarterly reports.

4.2 Particulate Data (PM_{10})

The measured inhalable particulate (PM_{10}) 24-hour average concentrations were well below the NAAQS standard of $150 \mu\text{g}/\text{m}^3$. Summary tables of each 6-day run were submitted and presented in each of the five quarterly reports. For the 15-month period where PM_{10} data was collected the highest 24-hour maximum concentration was $36.8 \mu\text{g}/\text{m}^3$ and the average concentration was $13.6 \mu\text{g}/\text{m}^3$. **Table 4-6** provides PM_{10} data summary results.

Table 4-6 PM_{10} Data Summary

	PM_{10} ($\mu\text{g}/\text{m}^3$) Primary Sampler (SCMM) Monthly Average	PM_{10} ($\mu\text{g}/\text{m}^3$) Collocated Sampler (SCMM) Monthly Average
April-07	13.0	11.9
May-07	19.4	16.9
June-07	23.9	23.1
July-07	24.2	21.9
August-07	17.6	18.6
September-07	15.1	15.9
October-07	13.7	14.2
November-07	15.5	15.3
December-07	6.9	6.6
January-08	5.2	5.4
February-08	8.3	8.6
March-08	4.7	4.7
April-08	9.9	9.8
May-08	13.4	13.2
June-08	12.6	11.9
Yearly Arithmetic Mean	13.6	13.2

4.2.1 Hi-vol Precision and Accuracy Statistics

Hi-Vol precision and accuracy statistics were compiled, presented, and submitted in each of the five quarterly reports.

4.3 Particulate Data – $PM_{2.5}$

Particulate matter with aerodynamic diameter less than $2.5 \mu\text{m}$ are tested using a Met One, BAM Model 1020, $PM_{2.5}$ particulate sampler. This instrument was equipped with a VSCC head on September 28, 2007 to achieve the FEM to generate hourly $PM_{2.5}$ concentrations using a fiber tape and internal carbon₁₄ radiation source. The ENSR technician performed $PM_{2.5}$ calibrations on a quarterly basis. Copies of the $PM_{2.5}$ quarterly calibration worksheets can be found in Appendix A.

Table 4-7 is PM_{2.5} data summary results.

Table 4-7 PM_{2.5} Data Summary (µg/m³)

	BAM #1 (Primary)		BAM #2 (Collocated)	
	PM _{2.5} Monthly Ave	PM _{2.5} 24-hour Max	PM _{2.5} Monthly Ave	PM _{2.5} 24-hour Max
Jul-07	13.8	20.6	NA	NA
Aug-07	10.7	18.3	NA	NA
Sep-07	9.9	25.2	NA	NA
Oct-07	4.0	10.8	NA	NA
Nov-07	4.6	22.0	NA	NA
Dec-07	2.9	6.9	1.5	13.0
Jan-08	3.0	8.6	1.7	6.5
Feb-08	4.2	12.4	3.1	12.6
Mar-08	3.8	9.5	2.5	8.5
Apr 08	4.7	10.7	3.0	10.3
May-08	5.1	19.9	4.8	20.5
Jun-08	3.2	10.4	3.8	9.5
Annual	5.8	25.2	2.9	20.5

5.0 Meteorological Data Summary

At the Basin site, meteorological data are collected in accordance with USEPA Meteorological Monitoring Guidance for Regulation Modeling Applications from an instrumented 100-m tower. The specific instruments and equipment are described in more detail below.

Tables 5-1 through 5-14 provide monthly data for the 15-month monitoring period.

Figures 5-1 through 5-11 provide graphical depiction of monthly data. The wind roses in **Figures 5-4 through 5-6** provide annual depictions of wind patterns, based on 12 months of wind data used in the modeling process.

5.1 Horizontal Wind Speed and Direction

Horizontal wind speeds and direction on the tower are measured continuously at the Basin site using Climatronics Model F460 wind systems (100075-G0-H0 for wind speed; 100076-G0-H0 for wind direction). Wind speed is measured using anemometers where the principle of operation is based on a light chopper that produces a frequency proportional to wind speed. The wind direction sensor is a lightweight balanced vane that senses position by a precision potentiometer. The wind sensors are installed at 10 m, 50 m, and 100 m. The standard deviation (σ_{θ}) of the wind direction is computed by the data logger using the USEPA preferred Yamartino method (USEPA 2000).

5.2 Temperature and Temperature Difference

Temperatures at the Basin site are measured at four levels on the tower using a Climatronics Model 100093 temperature system. This motor aspirated system includes dual element thermistors mounted at 100 m, 50 m, 10 m, and 2 m above ground level. Delta-T is calculated by the datalogger based on the difference in temperatures measured by identical sensors at each of the levels, 10-2 m, 100-50 m, and 50-10 m. The datalogger resolves the temperature difference to better than 0.1°C.

This sensor configuration is designed to provide complete signal wire compensation and to eliminate any measurement errors resulting from resistance of the signal cable. The aspirator is mechanically ventilated with a fan to prevent conductive interference from precipitation and radiation from solar and terrestrial sources.

5.3 Vertical Wind Speed and Standard Deviation

Vertical wind speeds on the tower are measured continuously at the Basin site using Climatronics Model 102236-G0 wind systems. Vertical wind speeds are measured using an anemometer where the principle of operation is based on a prop that rotates either clockwise or counter-clockwise, which corresponds to positive or negative voltages that are translated into upward and downward vertical wind speed. The wind sensors are installed at 100 m, 50 m, and 10 m. The standard deviation (σ_w) of the wind direction is computed by the data logger following the guidelines in USEPA (2000).

5.4 Solar Radiation

At the Basin site, radiation measurements using a Kipp & Zonen model CMP3 pyranometer located at about the 2m level. The sensor is designed for measurement of global (sun and sky) radiation. The detector is a differential thermopile made of plated copper on constantan junctions. Hot-junction receivers are covered with a stable black coating, cold junction receivers are whitened with non-hygroscopic barium sulfate. The sensor is temperature compensated using thermistor circuitry to within 1.5 percent of the range of -20°C to +40°C. The sensor is sensitive to wavelengths of 0.285 to 2.800 μm.

Table 5-1 10-meter Wind Speed Summary

	WS Monthly Average mps	WS Monthly Max mps	Date Max Occurred	WS Monthly Min mps	Date Min Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	5.5	17.2	04/19/07	0.8	04/17/07	497	720	69.0%
May-07	7.1	17.5	05/05/07	0.9	05/26/07	744	744	100.0%
Jun-07	5.6	16.4	06/18/07	0.7	06/27/07	468	720	65.0%
Jul-07	4.7	14.0	07/26/07	0.5	07/05/07	720	744	96.8%
Aug-07	4.5	11.6	08/10/07	0.4	08/20/07	744	744	100.0%
Sep-07	5.6	12.6	09/28/07	0.4	09/16/07	720	720	100.0%
Oct-07	5.7	15.9	10/30/07	0.6	10/12/07	744	744	100.0%
Nov-07	5.9	16.6	11/14/07	1.0	11/08/07	719	720	99.9%
Dec-07	4.5	14.5	12/21/07	0.1	12/27/07	606	744	81.5%
Jan-08	5.3	19.1	01/28/08	0.3	01/14/08	744	744	100.0%
Feb-08	5.3	17.5	02/17/08	0.5	02/05/08	696	696	100.0%
Mar-08	5.6	16.6	03/02/08	0.5	03/14/08	742	744	99.7%
Apr-08	6.6	15.1	04/20/08	0.6	04/21/08	692	720	96.1%
May-08	6.7	18.0	05/19/08	0.7	05/28/08	744	744	100.0%
Jun-08	5.3	15.4	06/11/08	0.5	06/29/08	714	720	99.2%
15-month	5.6	19.1	01/28/08	0.1	12/27/07	10294	10968	93.9%

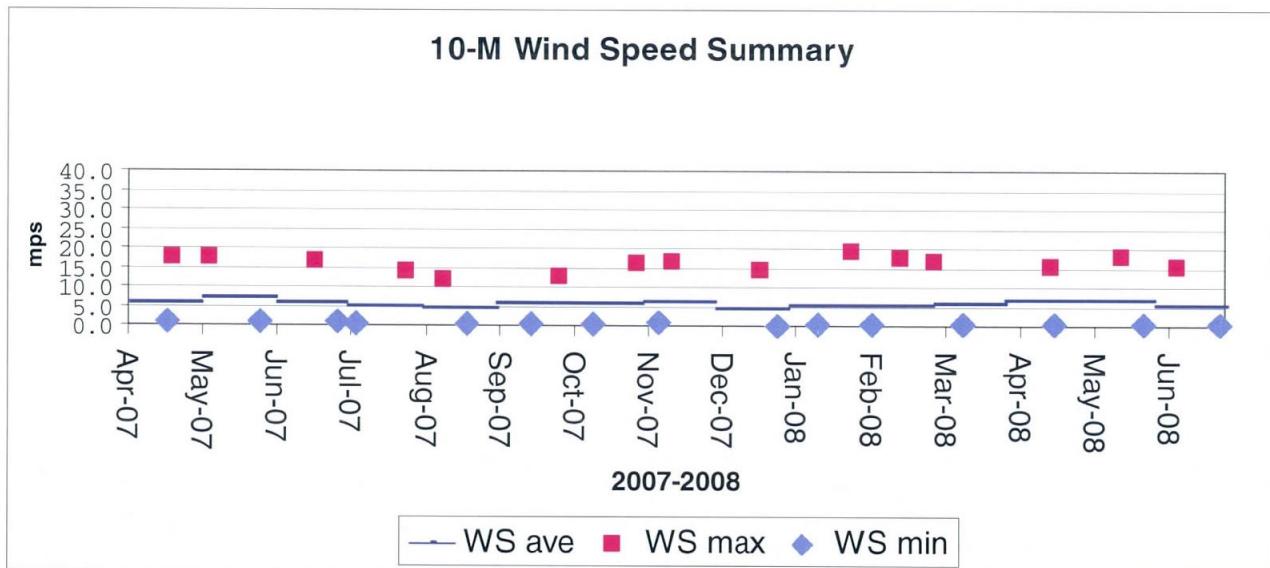
**Figure 5-1 10-meter Wind Speed Summary**

Table 5-2 50-meter Wind Speed Summary

	WS Monthly Average mps	WS Monthly Max mps	Date Max Occurred	WS Monthly Min mps	Date Min Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	7.3	19.9	4/17/07	1.1	4/25/07	517	720	71.8%
May-07	8.9	23.2	5/5/07	1.4	5/8/07	744	744	100.0%
Jun-07	7.7	19.7	6/18/07	0.9	6/27/07	468	720	65.0%
Jul-07	6.8	17.9	7/26/07	0.9	7/5/07	720	744	96.8%
Aug-07	6.4	15.0	8/3/07	0.6	8/23/07	744	744	100.0%
Sep-07	8.0	15.7	9/28/07	0.8	9/21/07	720	720	100.0%
Oct-07	7.8	19.0	10/30/07	0.9	10/08/07	744	744	100.0%
Nov-07	8.3	19.4	11/14/07	0.6	11/22/07	720	720	100.0%
Dec-07	6.6	16.8	12/13/07	0.2	12/28/07	662	744	89.0%
Jan-08	7.6	21.8	01/28/08	0.4	01/20/08	744	744	100.0%
Feb-08	7.0	20.3	02/17/08	0.1	02/04/08	696	696	100.0%
Mar-08	7.5	19.4	03/02/08	0.8	03/14/08	742	744	99.7%
Apr-08	8.8	18.2	4/20/08	0.8	4/28/08	692	720	96.1%
May-08	8.9	22.0	5/24/08	0.8	5/13/08	744	744	100.0%
Jun-08	7.0	20.3	6/11/08	0.7	6/22/08	714	720	99.2%
15-month	7.6	23.2	05/05/07	0.1	02/04/08	10371	10968	94.6%

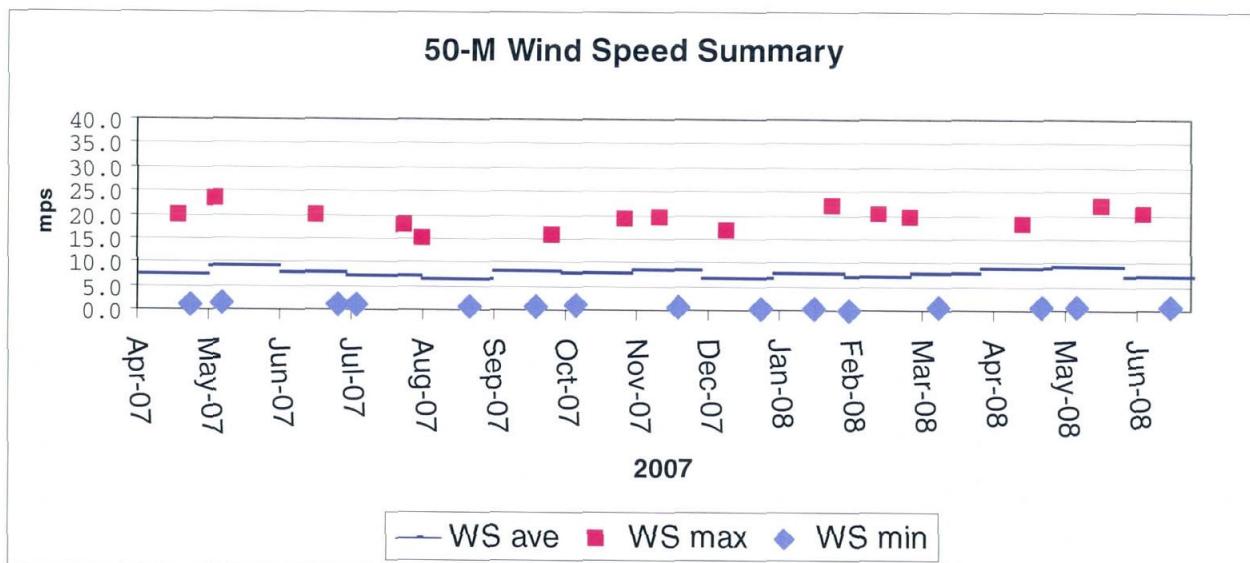
**Figure 5-2** 50-meter Wind Speed Summary

Table 5-3 100-meter Wind Speed Summary

	WS Monthly Average mps	WS Monthly Max mps	Date Max Occurred	WS Monthly Min mps	Date Min Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	8.2	20.7	4/19/07	1.0	4/12/07	517	720	71.8%
May-07	10.0	26.3	5/5/07	1.0	5/8/07	744	744	100.0%
Jun-07	8.0	18.9	6/25/07	0.1	6/18/07	468	720	65.0%
Jul-07	7.2	20.3	7/26/07	0.1	7/1/07	720	744	96.8%
Aug-07	7.3	17.4	8/3/07	0.6	8/23/07	744	744	100.0%
Sep-07	9.4	18.3	9/28/07	0.9	9/21/07	720	720	100.0%
Oct-07	9.0	20.9	10/30/07	1.1	10/03/07	744	744	100.0%
Nov-07	9.6	20.9	11/14/07	1.0	11/22/07	720	720	100.0%
Dec-07	7.2	18.1	12/21/07	0.1	12/28/07	617	744	82.9%
Jan-08	8.7	22.9	01/28/08	0.5	01/14/08	744	744	100.0%
Feb-08	7.7	21.8	02/17/08	0.1	02/04/08	696	696	100.0%
Mar-08	8.4	21.2	03/02/08	0.1	03/21/08	742	744	99.7%
Apr-08	9.7	19.3	4/15/08	0.1	4/6/08	692	720	96.1%
May-08	10.0	24.8	5/24/08	0.8	5/13/08	744	744	100.0%
Jun-08	7.9	23.0	6/11/08	0.5	6/22/08	714	720	99.2%
15 month	8.6	26.3	05/05/07	0.1	02/04/08	10326	10968	94.1%

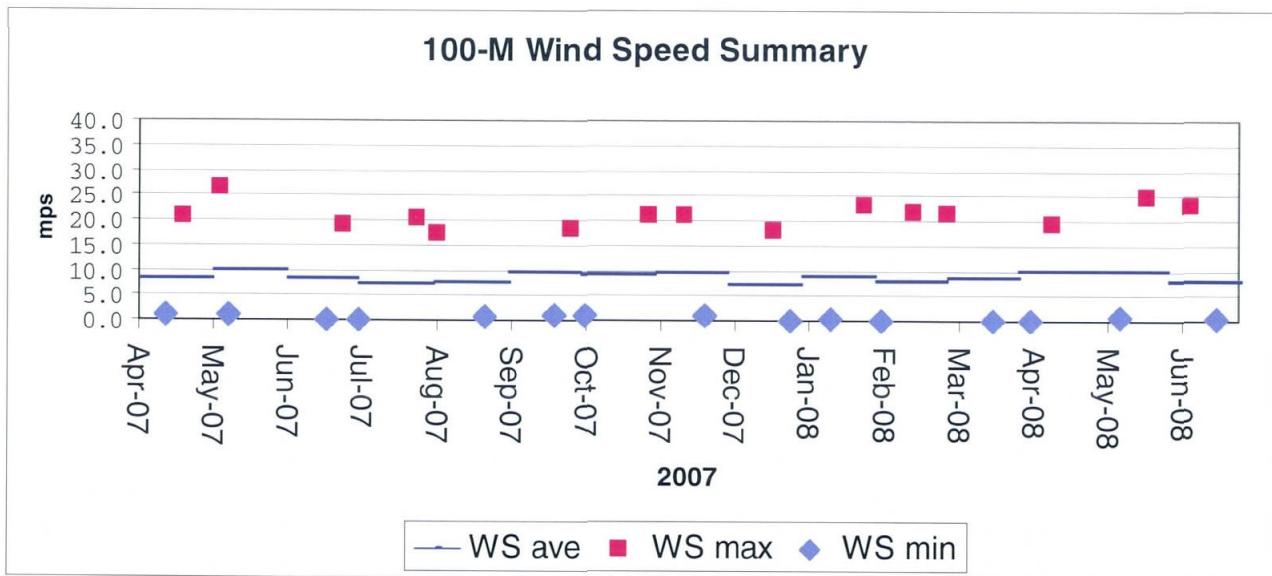
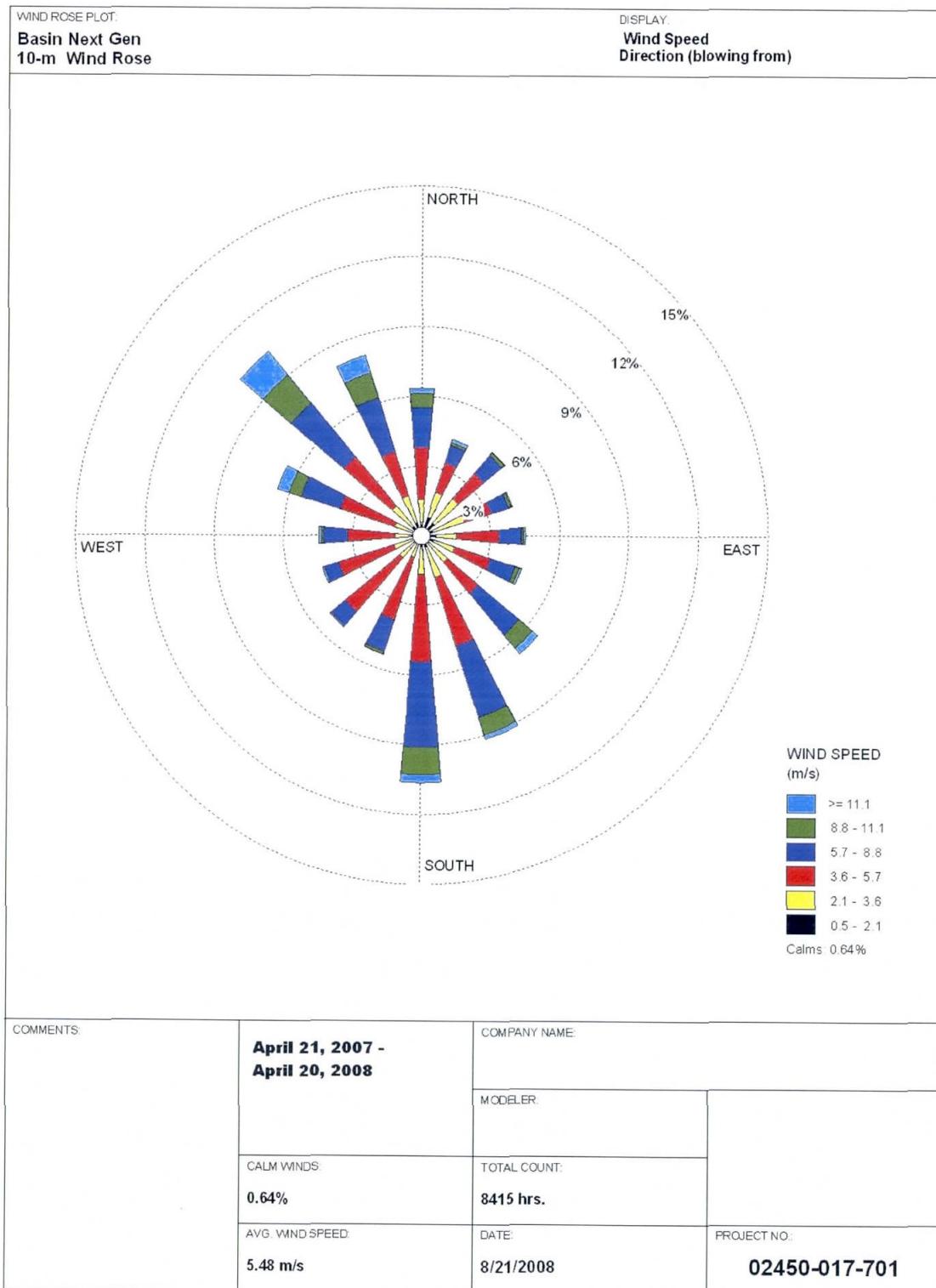


Figure 5-3 100-meter Wind Speed Summary

**Figure 5-4 10-meter Wind Rose**

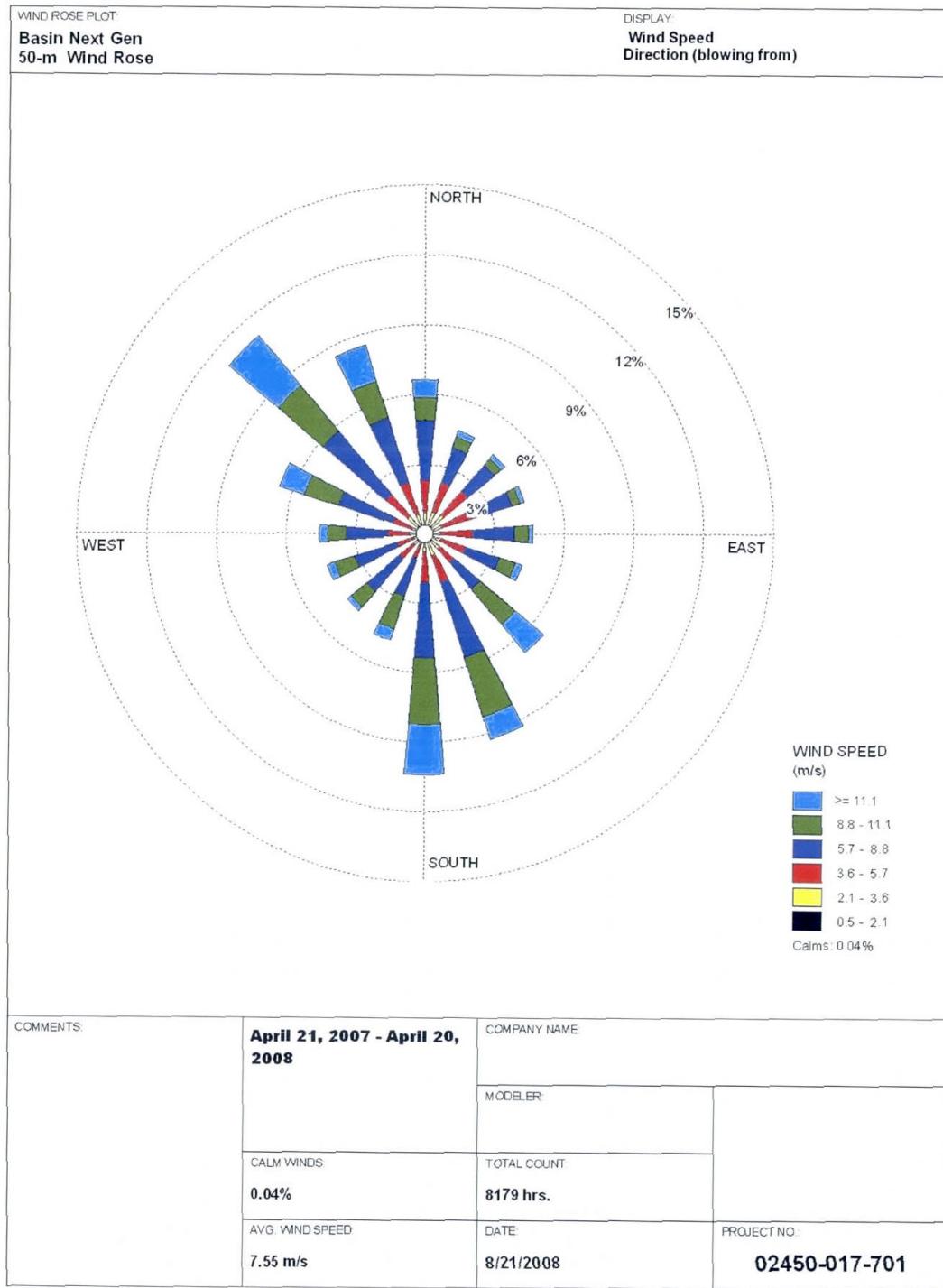


Figure 5-5 50-meter Wind Rose

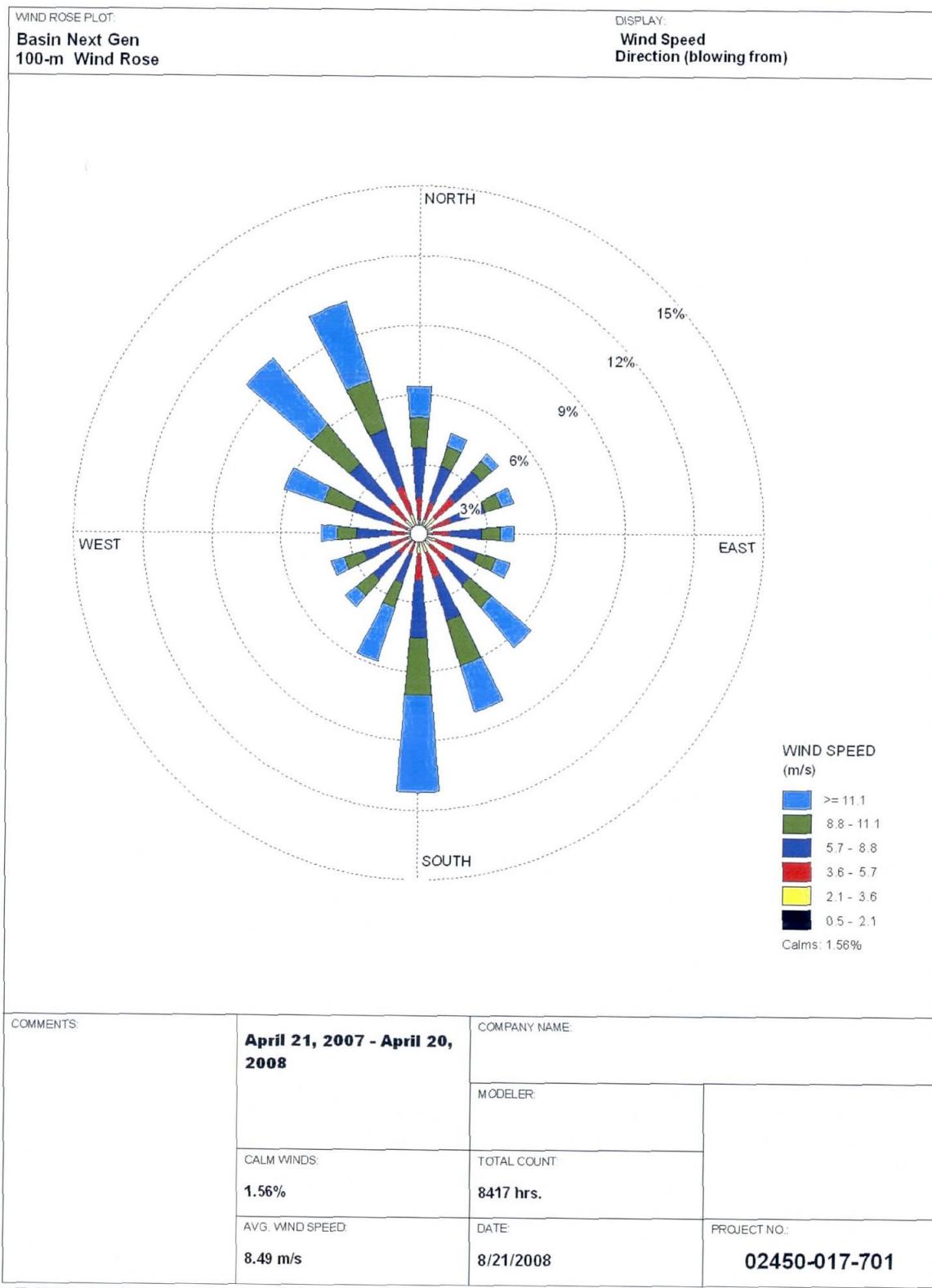
**Figure 5-6 100-meter Wind Rose**

Table 5-4 2-meter Temperature Summary

	Temp Monthly Average deg C	Temp Monthly Max deg C	Date Max Occurred	Temp Monthly Min Deg C	Date Min Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	7.1	26.4	4/28/07	-13.8	4/7/07	598	720	83.1%
May-07	14.7	32.1	5/13/07	1.8	5/17/07	744	744	100.0%
Jun-07	18.9	35.4	6/15/07	4.5	6/8/07	698	720	96.9%
Jul-07	23.2	37.7	7/7/07	10.1	7/11/07	732	744	98.4%
Aug-07	19.8	34.8	8/13/07	8.7	8/24/07	744	744	100.0%
Sep-07	15.8	36.0	9/3/07	0.3	9/14/07	719	720	99.9%
Oct-07	8.7	26.1	10/01/07	-3.1	10/27/07	744	744	100.0%
Nov-07	-0.1	18.7	11/04/07	-16.6	11/30/07	720	720	100.0%
Dec-07	-7.8	10.7	12/04/07	-18.1	12/08/07	744	744	100.0%
Jan-08	-9.7	8.2	01/28/08	-25.8	01/29/08	744	744	100.0%
Feb-08	-8.2	9.4	02/28/08	-28.8	02/20/08	696	696	100.0%
Mar-08	-1.2	16.1	03/24/08	-22.2	03/07/08	744	744	100.0%
Apr-08	5.1	30.7	04/15/08	-10.7	04/07/08	719	720	99.9%
May-08	11.2	27.2	05/16/08	-3.5	05/03/08	744	744	100.0%
Jun-08	16.9	29.6	06/24/08	5.6	06/12/08	718	720	99.7%
15 month	7.6	37.7	07/07/07	-28.8	02/20/08	10808	10968	98.5%

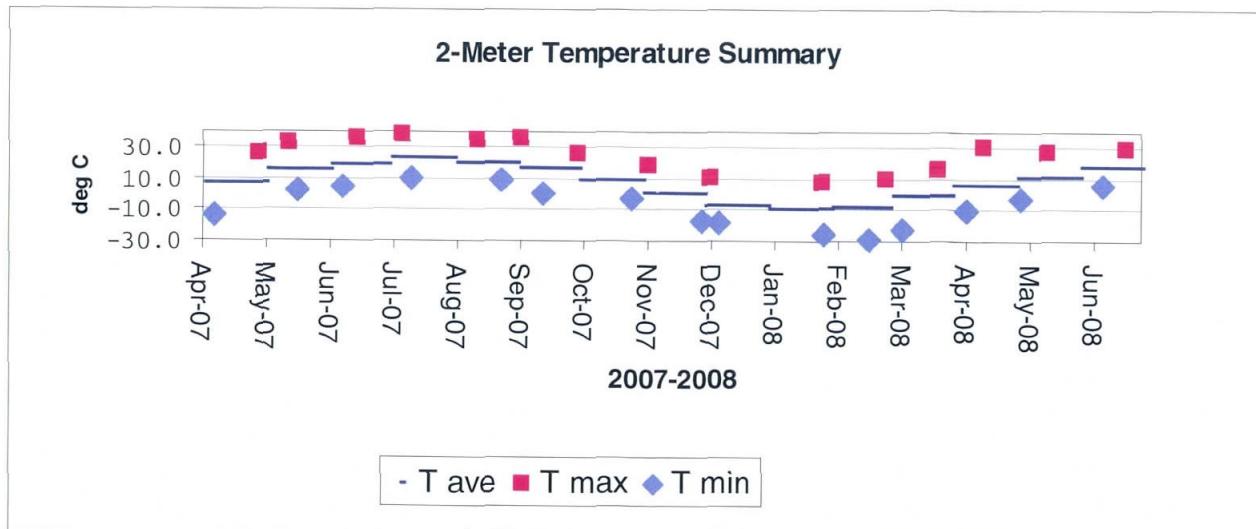
**Figure 5-7 2-meter Temperature Summary**

Table 5-5 10-meter Temperature Summary

	Temp Monthly Average deg C	Temp Monthly Max deg C	Date Max Occurred	Temp Monthly Min deg C	Date Min Occurred	Hours of Valid Data	Hours of Data Possible	Data Capture Percent
Apr-07	7.3	25.6	4/28/07	-13.5	4/7/07	588	720	81.7%
May-07	14.8	31.7	5/13/07	3.6	5/26/07	744	744	100.0%
Jun-07	19.4	31.8	6/25/07	8.3	6/28/07	467	720	64.9%
Jul-07	23.7	38.2	7/7/07	11.2	7/11/07	709	744	95.3%
Aug-07	20.1	35.2	8/13/07	10.0	8/24/07	744	744	100.0%
Sep-07	16.2	35.8	9/3/07	1.0	9/14/07	720	720	100.0%
Oct-07	9.2	25.8	10/01/07	-1.3	10/28/07	744	744	100.0%
Nov-07	0.3	18.5	11/04/07	-16.8	11/27/07	720	720	100.0%
Dec-07	-7.1	4.6	12/20/07	-16.6	12/08/07	662	744	89.0%
Jan-08	-9.3	8.4	01/28/08	-26.4	01/29/08	744	744	100.0%
Feb-08	-8.0	8.4	02/28/08	-28.9	02/20/08	696	696	100.0%
Mar-08	-1.1	15.6	03/24/08	-21.3	03/07/08	742	744	99.7%
Apr-08	5.2	30.2	4/15/08	-8.3	4/7/08	692	720	96.1%
May-08	11.3	26.3	5/16/08	-2.6	5/3/08	744	744	100.0%
Jun-08	17.3	29.4	6/24/08	4.5	6/10/08	714	720	99.2%
15 month	8.0	38.2	07/07/07	-28.9	02/20/08	10430	10968	95.1%

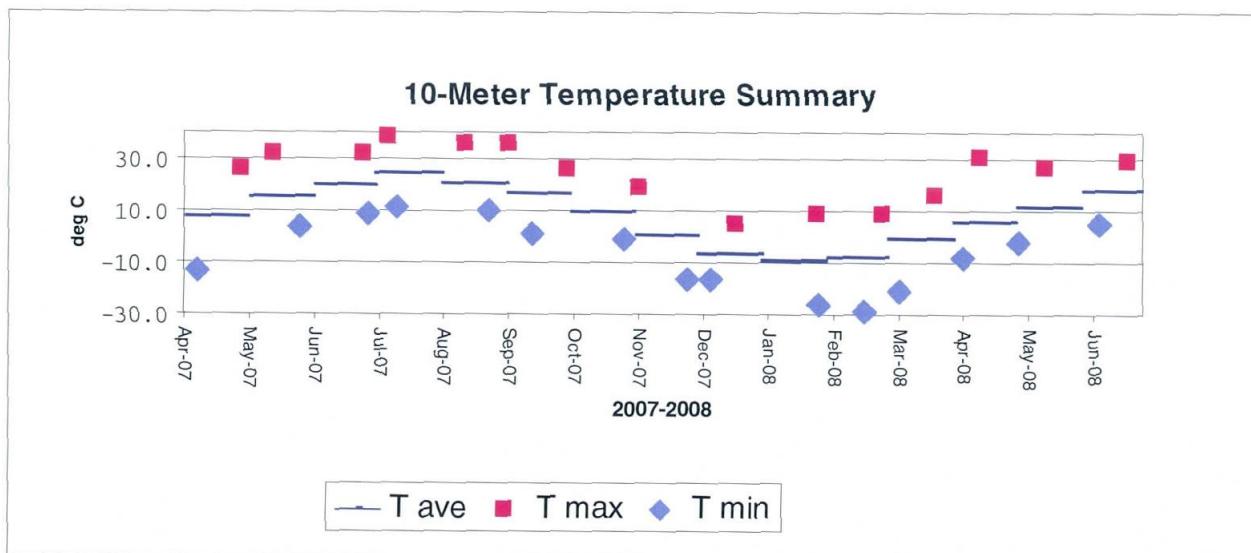
**Figure 5-8** 10-meter Temperature Summary

Table 5-6 50-meter Temperature Summary

	Temp Monthly Average deg C	Temp Monthly Max deg C	Date Max Occurred	Temp Monthly Min deg C	Date Min Occurred	Hours of Valid Data	Hours of Data Possible	Data Capture Percent
Apr-07	8.2	25.0	4/28/07	-12.8	4/7/07	572	720	79.4%
May-07	15.0	30.9	5/13/07	3.2	5/26/07	744	744	100.0%
Jun-07	19.6	31.6	6/25/07	8.5	6/28/07	467	720	64.9%
Jul-07	24.1	38.8	7/7/07	13.0	7/10/07	714	744	96.0%
Aug-07	20.4	35.5	8/13/07	10.9	8/24/07	744	744	100.0%
Sep-07	16.8	35.2	9/3/07	3.4	9/14/07	719	720	99.9%
Oct-07	10.0	25.2	10/01/07	-0.6	10/28/07	744	744	100.0%
Nov-07	1.1	18.0	11/04/07	-17.4	11/27/07	720	720	100.0%
Dec-07	-5.8	8.3	12/20/07	-16.5	12/08/07	662	744	89.0%
Jan-08	-8.3	11.0	01/28/08	-27.1	01/29/08	744	744	100.0%
Feb-08	-7.6	7.6	02/28/08	-29.3	02/20/08	696	696	100.0%
Mar-08	-0.7	15.1	03/24/08	-19.3	03/07/08	742	744	99.7%
Apr-08	5.6	29.6	4/15/08	-5.8	4/7/08	692	720	96.1%
May-08	11.6	25.3	5/16/08	0.1	5/2/08	744	744	100.0%
Jun-08	17.6	28.5	6/24/08	4.3	6/10/08	714	720	99.2%
15 month	8.5	38.8	07/07/07	-29.3	02/20/08	10418	10968	95.0%

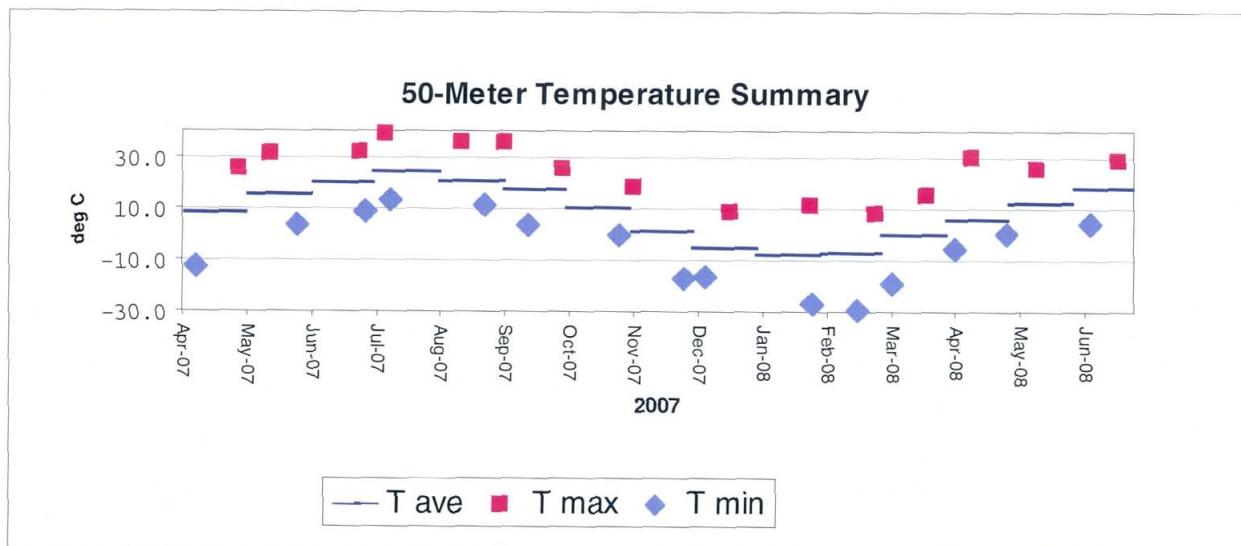
**Figure 5-9 50-meter Temperature Summary**

Table 5-7 100-meter Temperature Summary

	Temp Monthly Average deg C	Temp Monthly Max deg C	Date Max Occurred	Temp Monthly Min deg C	Date Min Occurred	Hours Of Valid Data	Hours of Data Possible	Valid Data Capture Percent
Apr-07	7.9	24.5	4/28/07	-12.6	4/7/07	588	720	81.7%
May-07	14.9	30.4	5/13/07	2.6	5/26/07	744	744	100.0%
Jun-07	19.6	31.3	6/25/07	8.8	6/28/07	467	720	64.9%
Jul-07	24.3	38.6	7/7/07	12.7	7/10/07	708	744	95.2%
Aug-07	20.4	35.0	8/13/07	11.1	8/25/07	744	744	100.0%
Sep-07	16.9	34.8	9/3/07	3.8	9/14/07	720	720	100.0%
Oct-07	10.1	24.8	10/01/07	0.5	10/11/07	744	744	100.0%
Nov-07	1.4	17.4	11/04/07	-17.9	11/27/07	720	720	100.0%
Dec-07	-5.1	8.9	12/20/07	-16.8	12/08/07	662	744	89.0%
Jan-08	-7.6	12.8	01/28/08	-27.6	01/29/08	744	744	100.0%
Feb-08	-7.4	7.1	02/28/08	-29.7	02/20/08	696	696	100.0%
Mar-08	-0.7	15.0	03/11/08	-19.0	03/07/08	742	744	99.7%
Apr-08	5.6	29.0	4/15/08	-5.3	4/6/08	692	720	96.1%
May-08	11.6	24.6	5/16/08	-0.2	5/2/08	744	744	100.0%
Jun-08	17.6	27.9	6/24/08	4.1	6/10/08	714	720	99.2%
15 month	8.6	38.6	07/07/07	-29.7	02/20/08	10429	10968	95.1%

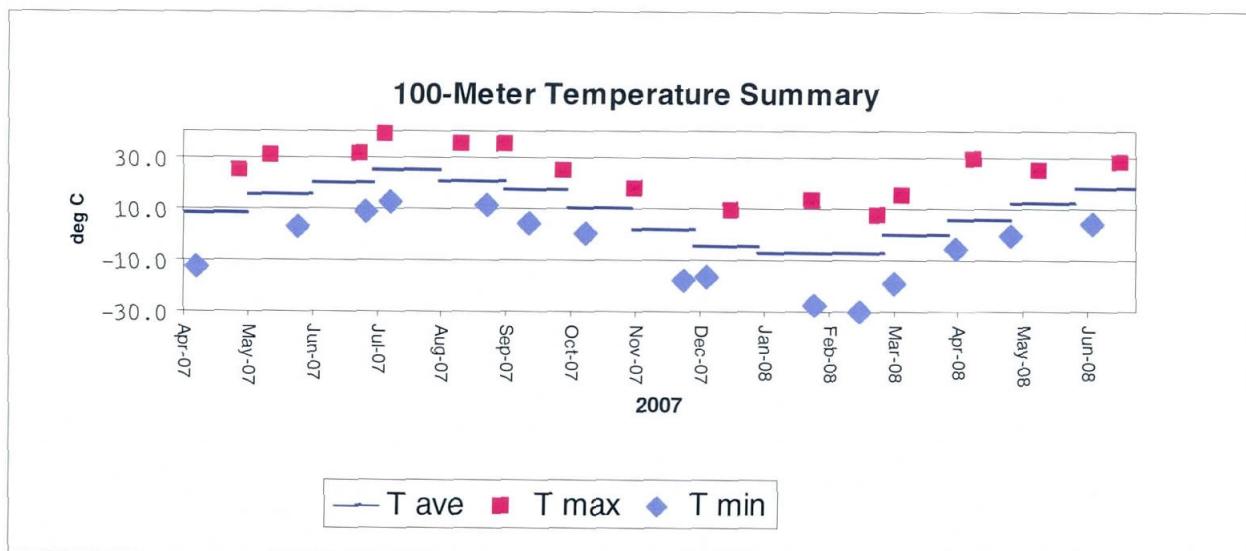


Figure 5-10 100-meter Temperature Summary

Table 5-8 10-2 Delta Temperature Summary

	Delta T Monthly Average deg C	Delta T Monthly Max deg C	Date Max Occurred	Delta T Monthly Min deg C	Date Min Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	0.27	5.57	04/14/07	-5.47	04/09/07	588	720	81.7%
May-07	0.08	5.39	05/08/07	-1.69	05/24/07	744	744	100.0%
Jun-07	0.26	5.48	06/26/07	-1.28	06/28/07	467	720	64.9%
Jul-07	0.39	4.69	07/03/07	-2.32	07/12/07	707	744	95.0%
Aug-07	0.26	6.20	08/21/07	-1.49	08/14/07	744	744	100.0%
Sep-07	0.42	7.34	09/12/07	-1.53	09/12/07	719	720	99.9%
Oct-07	0.50	8.71	10/30/07	-1.57	10/06/07	744	744	100.0%
Nov-07	0.38	4.71	11/02/07	-1.09	11/08/07	720	720	100.0%
Dec-07	0.68	7.89	12/20/07	-0.95	12/11/07	662	744	89.0%
Jan-08	0.39	5.50	01/19/08	-1.28	01/15/08	744	744	100.0%
Feb-08	0.20	5.76	02/22/08	-1.41	02/18/08	696	696	100.0%
Mar-08	0.19	4.97	03/26/08	-1.73	03/25/08	742	744	99.7%
Apr-08	0.24	6.54	04/02/08	-7.72	04/10/08	691	720	96.0%
May-08	0.15	5.98	05/05/08	-1.70	05/03/08	744	744	100.0%
Jun-08	0.38	5.96	06/30/08	-9.74	06/10/08	713	720	99.0%
Deg C / 8 meter height difference								
Apr-07	0.03	0.70	04/14/07	-0.68	04/09/07	588	720	81.7%
May-07	0.01	0.67	05/08/07	-0.21	05/24/07	744	744	100.0%
Jun-07	0.03	0.69	06/26/07	-0.16	06/28/07	467	720	64.9%
Jul-07	0.05	0.59	07/03/07	-0.29	07/12/07	707	744	95.0%
Aug-07	0.03	0.78	08/21/07	-0.19	08/14/07	744	744	100.0%
Sep-07	0.05	0.92	09/12/07	-0.19	09/12/07	719	720	99.9%
Oct-07	0.06	1.09	10/30/07	-0.20	10/06/07	744	744	100.0%
Nov-07	0.05	0.59	11/02/07	-0.14	11/08/07	720	720	100.0%
Dec-07	0.09	0.99	12/20/07	-0.12	12/11/07	662	744	89.0%
Jan-08	0.05	0.69	01/19/08	-0.16	01/15/08	744	744	100.0%
Feb-08	0.03	0.72	02/22/08	-0.18	02/18/08	696	696	100.0%
Mar-08	0.02	0.62	03/26/08	-0.22	03/25/08	742	744	99.7%
Apr-08	0.03	0.82	04/02/08	-0.97	04/10/08	691	720	96.0%
May-08	0.02	0.75	05/05/08	-0.21	05/03/08	744	744	100.0%
Jun-08	0.05	0.75	06/30/08	-1.22	06/10/08	713	720	99.0%

Table 5-9 50-10 Delta Temperature Summary

	Delta T Monthly Average deg C	Delta T Monthly Max deg C	Date Max Occurred	Delta T Monthly Min deg C	Date Min Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	0.59	6.47	04/29/07	-3.56	04/20/07	572	720	79.4%
May-07	0.21	5.47	05/09/07	-1.33	05/20/07	744	744	100.0%
Jun-07	0.27	4.33	06/19/07	-1.05	06/18/07	467	720	64.9%
Jul-07	0.45	5.60	07/16/07	-2.59	07/26/07	707	744	95.0%
Aug-07	0.29	5.64	08/22/07	-2.13	08/28/07	744	744	100.0%
Sep-07	0.55	7.01	09/16/07	-1.15	09/13/07	719	720	99.9%
Oct-07	0.72	8.42	10/30/07	-1.03	10/02/07	744	744	100.0%
Nov-07	0.81	6.46	11/03/07	-1.00	11/27/07	720	720	100.0%
Dec-07	1.28	7.61	12/20/07	-0.72	12/09/07	662	744	89.0%
Jan-08	1.08	8.72	01/05/08	-1.70	01/15/08	744	744	100.0%
Feb-08	0.43	7.10	02/22/08	-1.15	02/02/08	696	696	100.0%
Mar-08	0.34	9.06	03/10/08	-1.07	03/25/08	742	744	99.7%
Apr-08	0.37	6.98	04/10/08	-1.84	04/07/08	691	720	96.0%
May-08	0.30	6.75	05/16/08	-1.21	05/17/08	744	744	100.0%
Jun-08	0.40	4.84	06/21/08	-1.66	06/03/08	714	720	99.2%
Deg C / 40 meter height difference								
Apr-07	0.01	0.16	04/29/07	-0.09	04/20/07	572	720	79.4%
May-07	0.01	0.14	05/09/07	-0.03	05/20/07	744	744	100.0%
Jun-07	0.01	0.11	06/19/07	-0.03	06/18/07	467	720	64.9%
Jul-07	0.01	0.14	07/16/07	-0.06	07/26/07	707	744	95.0%
Aug-07	0.01	0.14	08/22/07	-0.05	08/28/07	744	744	100.0%
Sep-07	0.01	0.18	09/16/07	-0.03	09/13/07	719	720	99.9%
Oct-07	0.02	0.21	10/30/07	-0.03	10/02/07	744	744	100.0%
Nov-07	0.02	0.16	11/03/07	-0.03	11/27/07	720	720	100.0%
Dec-07	0.03	0.19	12/20/07	-0.02	12/09/07	662	744	89.0%
Jan-08	0.03	0.22	01/05/08	-0.04	01/15/08	744	744	100.0%
Feb-08	0.01	0.18	02/22/08	-0.03	02/02/08	696	696	100.0%
Mar-08	0.01	0.23	03/10/08	-0.03	03/25/08	742	744	99.7%
Apr-08	0.01	0.17	04/10/08	-0.05	04/07/08	691	720	96.0%
May-08	0.01	0.17	05/16/08	-0.03	05/17/08	744	744	100.0%
Jun-08	0.01	0.12	06/21/08	-0.04	06/03/08	714	720	99.2%

Table 5-10 100-50 Delta Temperature Summary

	Delta T Monthly Average deg C	Delta T Monthly Max deg C	Date Max Occurred	Delta T Monthly Min deg C	Date Min Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	0.04	4.10	04/21/07	-0.95	04/08/07	572	720	79.4%
May-07	-0.11	3.44	05/13/07	-0.80	05/20/07	744	744	100.0%
Jun-07	-0.03	2.23	06/30/07	-0.67	06/19/07	467	720	64.9%
Jul-07	0.16	6.63	07/12/07	-1.38	07/27/07	706	744	94.9%
Aug-07	0.02	3.51	08/10/07	-1.06	08/20/07	744	744	100.0%
Sep-07	0.11	3.93	09/16/07	-0.75	09/21/07	719	720	99.9%
Oct-07	0.15	4.40	10/30/07	-0.70	10/02/07	744	744	100.0%
Nov-07	0.34	5.07	11/24/07	-0.64	11/17/07	720	720	100.0%
Dec-07	0.74	7.64	12/04/07	-0.58	12/09/07	662	744	89.0%
Jan-08	0.63	7.09	01/05/08	-0.81	01/15/08	744	744	100.0%
Feb-08	0.18	5.96	02/15/08	-0.72	02/25/08	696	696	100.0%
Mar-08	-0.01	3.53	03/11/08	-0.88	03/21/08	742	744	99.7%
Apr-08	0.02	3.95	04/24/08	-0.70	04/20/08	691	720	96.0%
May-08	-0.05	3.44	05/16/08	-1.02	05/25/08	744	744	100.0%
Jun-08	-0.04	3.12	06/19/08	-0.94	06/13/08	714	720	99.2%
Deg C / 50 meter height difference								
Apr-07	0.00	0.08	04/21/07	-0.02	04/08/07	572	720	79.4%
May-07	0.00	0.07	05/13/07	-0.02	05/20/07	744	744	100.0%
Jun-07	0.00	0.04	06/30/07	-0.01	06/19/07	467	720	64.9%
Jul-07	0.00	0.13	07/12/07	-0.03	07/27/07	706	744	94.9%
Aug-07	0.00	0.07	08/10/07	-0.02	08/20/07	744	744	100.0%
Sep-07	0.00	0.08	09/16/07	-0.02	09/21/07	719	720	99.9%
Oct-07	0.00	0.09	10/30/07	-0.01	10/02/07	744	744	100.0%
Nov-07	0.01	0.10	11/24/07	-0.01	11/17/07	720	720	100.0%
Dec-07	0.01	0.15	12/04/07	-0.01	12/09/07	662	744	89.0%
Jan-08	0.01	0.14	01/05/08	-0.02	01/15/08	744	744	100.0%
Feb-08	0.00	0.12	02/15/08	-0.01	02/25/08	696	696	100.0%
Mar-08	0.00	0.07	03/11/08	-0.02	03/21/08	742	744	99.7%
Apr-08	0.00	0.08	04/24/08	-0.01	04/20/08	691	720	96.0%
May-08	0.00	0.07	05/16/08	-0.02	05/25/08	744	744	100.0%
Jun-08	0.00	0.06	06/19/08	-0.02	06/13/08	714	720	99.2%

Table 5-11 Solar Radiation Summary

	Sol Rad Monthly Total w/m²	Sol Rad 24 hour Max w/m²	Sol Rad 1 hour Max w/m²	Date 1 hour Max Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	130450	7270	880	4/17/07	604	720	83.9%
May-07	184461	7799	905	5/14/07	744	744	100.0%
Jun-07	188287	8318	939	6/8/07	698	720	96.9%
Jul-07	207311	8316	927	7/6/07	734	744	98.7%
Aug-07	140500	6968	836	8/2/07	744	744	100.0%
Sep-07	127844	5932	760	9/2/07	720	720	100.0%
Oct-07	81131	4712	639	10/01/07	744	744	100.0%
Nov-07	57696	2992	477	11/01/07	720	720	100.0%
Dec-07	49994	2456	523	12/12/07	744	744	100.0%
Jan-08	60015	2917	528	01/24/08	744	744	100.0%
Feb-08	81742	4397	623	02/29/08	696	696	100.0%
Mar-08	117296	5725	865	03/27/08	744	744	100.0%
Apr-08	166064	7409	884	4/28/08	720	720	100.0%
May-08	159953	7996	938	5/31/08	744	744	100.0%
Jun-08	192993	8461	942	6/16/08	718	720	99.7%

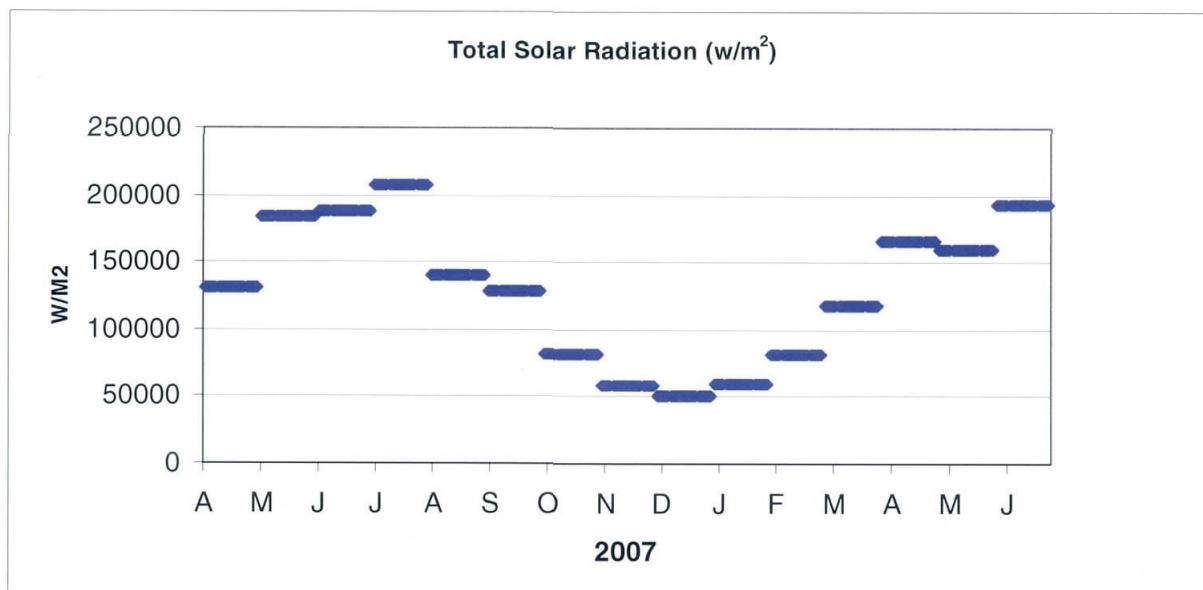
**Figure 5-11 Solar Radiation**

Table 5-12 Relative Humidity

	RH% Monthly Average	RH% Monthly Max	Date Max Occurred	RH% Monthly Min	Date Min Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	63.2	99.1	4/21/07	18.7	4/28/07	602	720	83.6%
May-07	69.2	99.0	5/5/07	26.3	5/8/07	744	744	100.0%
Jun-07	74.7	98.3	6/14/07	29.1	6/9/07	720	720	100.0%
Jul-07	66.3	97.8	7/3/07	23.6	7/7/07	731	744	98.3%
Aug-07	75.9	99.1	8/19/07	24.0	8/2/07	744	744	100.0%
Sep-07	66.8	98.8	9/9/07	21.4	9/29/07	719	720	99.9%
Oct-07	72.2	99.0	10/17/07	20.9	10/3/07	744	744	100.0%
Nov-07	64.0	97.8	11/18/07	21.6	11/2/07	720	720	100.0%
Dec-07	82.3	97.0	12/15/07	32.3	12/18/07	744	744	100.0%
Jan-08	76.5	98.6	01/15/08	42.6	01/30/08	744	744	100.0%
Feb-08	77.5	99.4	02/04/08	35.6	02/07/08	696	696	100.0%
Mar-08	70.5	100.0	03/20/08	20.9	03/24/08	744	744	100.0%
Apr-08	59.0	100.0	04/10/08	10.0	04/15/08	720	720	100.0%
May-08	65.1	99.1	05/30/08	18.1	05/17/08	744	744	100.0%
Jun-08	69.5	98.7	06/03/08	20.5	06/01/08	719	720	99.9%

Table 5-13 Barometric Pressure Summary

	Pressure Monthly Average (mb)	Pressure Monthly Max (mb)	Date Max Occurred	Pressure Monthly Min (mb)	Date Min Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	705	720	4/6/07	699	4/19/07	602	720	83.6%
May-07	705	714	5/16/07	695	5/21/07	744	744	100.0%
Jun-07	704	714	6/28/07	683	6/6/07	720	720	100.0%
Jul-07	707	847	7/23/07	697	7/7/07	737	744	99.1%
Aug-07	706	715	8/12/07	698	8/20/07	744	744	100.0%
Sep-07	705	716	9/9/07	694	9/21/07	720	720	100.0%
Oct-07	705	719	10/27/07	690	10/18/07	744	744	100.0%
Nov-07	707	717	11/06/07	695	11/13/07	720	720	100.0%
Dec-07	706	717	12/08/07	697	12/21/07	744	744	100.0%
Jan-08	705	722	01/02/08	683	01/28/08	744	744	100.0%
Feb-08	705	719	02/10/08	694	02/13/08	696	696	100.0%
Mar-08	706	719	03/22/08	693	03/01/08	744	744	100.0%
Apr-08	705	715	4/13/08	688	4/15/08	720	720	100.0%
May-08	703	715	5/27/08	692	5/1/08	744	744	100.0%
Jun-08	704	712	6/29/08	687	6/6/08	720	720	100.0%

Table 5-14 Precipitation Summary

	Precip. Monthly Total Inches	Precip. 24 hour Max Inches	Precip. 1 hour Max Inches	Date 1 hour Max Occurred	Hours of QA/QC Data	Hours of Data Possible	Data Capture Percent
Apr-07	1.56	0.66	0.42	4/20/07	606	720	84.2%
May-07	4.58	2.33	0.96	5/22/07	744	744	100.0%
Jun-07	3.67	1.98	0.78	6/12/07	720	720	100.0%
Jul-07	1.86	1.53	1.41	7/13/07	734	744	98.7%
Aug-07	5.85	2.12	1.04	8/3/07	744	744	100.0%
Sep-07	1.26	0.45	0.30	9/8/07	720	720	100.0%
Oct-07	3.81	1.51	0.81	10/06/07	744	744	100.0%
Nov-07	0.00	0.00	0.00	NA	720	720	100.0%
Dec-07	0.14	0.13	0.03	12/01/07	739	744	99.3%
Jan-08	0.00	0.00	0.00	01/01/08	744	744	100.0%
Feb-08	0.07	0.04	0.01	02/04/08	696	696	100.0%
Mar-08	0.31	0.09	0.05	03/27/08	744	744	100.0%
Apr-08	0.36	0.10	0.04	4/9/08	718	720	99.7%
May-08	1.59	0.51	0.30	5/6/08	744	744	100.0%
June-08	5.23	1.66	1.12	6/11/08	720	720	100.0%

5.5 Relative Humidity (RH)

RH is measured, at 2 m, using a Campbell Scientific model HMP 45C-L humidity sensor. The sensing element is a small hygroscopic thin film capacitor that modifies its value as a function of both the water vapor pressure and temperature of the environment. The sensor probe electronics automatically compensate for temperature effects on the probe. Sensor output signals are data logger compatible requiring no additional processing.

5.6 Barometric Pressure

Barometric pressure is measured using a Climatronics Model 102663-G0-10 pressure sensor. The pressure sensor is a piezoresistive device. The sensor is ideally suited to applications requiring accurate measurement of pressure. The sensor provides 0-1V DC over a 600 to 1,100 hPascals range.

5.7 Precipitation

A Climatronics Model 100097-1-G0 6-inch tipping bucket precipitation gauge is used to measure rainfall. Precipitation is channeled to a triangular bucket that tips once for each 0.01 inch of water collected. When the bucket empties, it activates a switch that is monitored and recorded by the data acquisition system.

5.8 Data Accuracy

Independent quality assurance audits were done by ARS on a quarterly basis. Results and copies of those audits are found in the quarterly reports.

6.0 References

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- Yamartino, R. J. 1984. A Comparison of Several "Single Pass" Estimators of the Standard Deviation of Wind.

Appendix A

PM_{2.5} Quarterly Calibrations

CARB MONTHLY QUALITY CONTROL MAINTENANCE CHECK SHEET
BAM-1020 SAMPLER

AQSB SOP 400
 BAM-1020
 First Edition, May 2003

Site Name:
 Site Number:
 Operator/Agency:

Roslyn 27th Ave
 Gofferville

Month/Year:
 Sampler Make & Model:
 Sampler ID Number:
 Date of Last Calibration:

7/07
 Metone BAM 1020
 65494
 6-19-2007

Instrument Checks:

- 1) Daily checks: Review station data logger values for correct operation of BAM-1020.
- 2) Weekly checks: Check filter tape & replace when necessary (approx. 2 months per roll).
- 3) Bi-Weekly checks: Perform BAM-1020 flow and leak.
- 4) Monthly checks: Complete and submit this Monthly Quality Control Check Sheet.
 Thoroughly clean both PM2.5 SCC and PM10 FRM inlets.
 Check pump muffler and replace when needed.
 Download and submit data from BAM-1020 data logger.

Sampler Flow Rate, Ambient Temp and Pressure Check Results:

	Flow Rate Standard	Temperature Standard	Pressure Standard
Standard Make/Model:	Bios DC-1	Tahne 304004	A12-HB-2A
Std. ARB ID Number:			
Std. Certification Date:	1/10/2007	1/10/2007	1/17/2007
Standard Slope:			
Standard Intercept:			
Date Checked:	7/10/07		
Std. Display Reading:			703
Std. 'Actual' Reading:	17.8 (16.7)	20.1	703
BAM-1020 Display:	16.7	20.1	
Design Flow % Diff.:			
Leak Check Value:	0.3		

Volumetric Flow Acceptance Criteria: $\leq \pm 1.4\%$ of 16.67 LPM (16.00 to 17.34 VLPM)

Operator Comments: New installation of 2 units, for mechanical fit testing, removing one to return for factory recalibration.

Reviewed by:

Appendix A

AQSB QC Form 400 (BAM)

CARB MONTHLY QUALITY CONTROL MAINTENANCE CHECK SHEET
BAM-1020 SAMPLER

Site Name: Basin Electric Month/Year: 9/07
Site Number: Gettysburg Sampler Make & Model: Met One BAM 1020
Operator/Agency: ENSP Sampler ID Number: G4595
Date of Last Calibration: 8-22-2007

Instrument Checks:

- 1) Daily checks: Review station data logger values for correct operation of BAM-1020.
- 2) Weekly checks: Check filter tape & replace when necessary (approx. 2 months per roll).
- 3) Bi-Weekly checks: Perform BAM-1020 flow and leak.
- 4) Monthly checks: Complete and submit this Monthly Quality Control Check Sheet.
Thoroughly clean both PM2.5 SCC and PM10 FRM inlets.
Check pump muffler and replace when needed.
Download and submit data from BAM-1020 data logger.

Sampler Flow Rate, Ambient Temp and Pressure Check Results:

	Flow Rate Standard	Temperature Standard	Pressure Standard
Standard Make/Model:	<u>BIOS DC-1</u>	<u>Techne 304004</u>	<u>AIR air-hb-2-a 3C 2420</u>
Std. ARB ID Number:			
Std. Certification Date:	<u>1/10/07</u>	<u>1/10/2007</u>	<u>1/17/2007</u>
Standard Slope:			
Standard Intercept:			
Date Checked:	<u>9/29/07</u>		
Std. Display Reading:	<u>17.7</u>		
Std. 'Actual' Reading:	<u>16.7</u>	<u>22.3</u>	<u>709</u>
BAM-1020 Display:	<u>16.7</u>	<u>22.3</u>	<u>709</u>
Design Flow % Diff.:			
Leak Check Value:			

Volumetric Flow Acceptance Criteria: $\pm 4\%$ of 16.67 LPM (16.00 to 17.34 VLPM)

Operator Comments:

New upgraded unit installed at "desk" position.

Reviewed by _____

Appendix A

AQSB QC Form 400 (BAM)

STATION 1
BAM 1020 Calibration Sheet

Model:	1020
S/N	G 4595
Audit Date:	12/5/2007

Audited By: BCJ

Flow Audits			
	Model	S/N	Cal Date:
Flow Reference Standard Used:	Bios DC-HC-1	1837	1/15/2007
Temperature Standard Used:	Techne 4400	304004	1/10/2007
Barometric Standard Used:	AIR -HB-2A	3C2430	1/17/2007

Leak Check Value (LPM): as found: 0.2 as left: 0.2

	BAM	Ref. Std.		BAM	Ref. Std.
Ambient Temperature:	as found: -6.8	-6.8	C	as left: -6.8	-6.8
Barometric Pressure:	as found: 713	713	mmHg	as left: 713	713
Flow Rate (Actual Volumetric):	as found: 16.7	16.7	lpm	as left: 16.7	16.7
Flow Rate (EPA Standard):	as found:		lpm	as left:	

Mechanical Audits	
as found:	as left:
Pump muffler unclogged:	yes
Sample nozzle clean:	yes
Tape support vane clean:	yes
Capstan shaft clean:	yes
Rubber pinch rollers clean:	yes
Chassis Ground wire installed:	yes
PM 10 Particle trap clean:	yes
PM 10 drip jar empty:	yes
PM 10 bug screen clear:	yes
PM 2.5 particle trap clean:	yes
Inlet tube water tight seal OK:	yes
Inlet tube perpendicular to BAM:	yes

Flow Control Range	
Flow Set point (LPM)	BAM Flow (LPM)
15	15.0
16.7	16.7
18.4	18.4

Membrane Audit	
LAST m (mg):	0.8
ABS (mg):	0.796
Difference (mg):	-0.004
% Difference:	-0.50

Setup and Calibration Values								
Parameter	Expected	Found	Parameter	Expected	Found	Parameter	Expected	Found
Clock time/date	OK	OK	FLOW TYPE	Actual	Actual	AP	150	150
RS232	9600 8N1	9600 8N1	Cv	0.998	0.998	FR1	10	10
STATION #	1	1	Qo	0.000	0.000	FRH	20	20
RANGE (mg)	1.00	1.00	ABS	0.796	0.796	Password	F1 F2 F3 F4	F1 F2 F3 F4
BAM SAMPLE (min)	42	42	μsw:	0.306	0.306	Cycle Mode	Standard	Standard
MET SAMPLE (min)	60	60	K FACTOR	0.956	0.956	RH Control	Yes	Yes
OFFSET (mg)	-0.015	-0.015	BKGD	-0.0032	-0.0032	RH Set point (%)	35	35
CONC. UNITS	mg/m ³	mg/m ³	STD TEMP (C°)	25	25	Datalog RH (CH4)	Yes	Yes
COUNT TIME (min)	8	8	HEATER	Auto	Auto	Delta-T Control	No	No
FLOW RATE (LPM)	16.7	16.7	e1	-0.005	-0.005	Delta-T Set. (C°)	10	10
CONC. TYPE	Actual	Actual	Errors	none	none	Datalog D/T (CH5)	Yes	Yes

Last 6 Errors in BAM 1020 Error Log					
Error	Date	Time	Error	Date	Time
1			4		
2			5		
3			6		

Comments:

ANSWER

STATION 2
BAM 1020 Calibration Sheet

Model:	1020
S/N	G 4594
Audit Date:	12/5/2007

Audited By: BCJ

Flow Audits			
	Model	S/N	Cal Date:
Flow Reference Standard Used:	Bios DC-HC-1	1837	1/15/2007
Temperature Standard Used:	Techne 4400	304004	1/10/2007
Barometric Standard Used:	AIR-HB-2A	3C2430	1/17/2007

Leak Check Value (LPM): as found: 0.2

as left: 0.2

	BAM	Ref. Std.		BAM	Ref. Std.
Ambient Temperature:	as found: -6.8	-6.8	C	as left: -6.8	-6.8
Barometric Pressure:	as found: 713	713	mmHg	as left: 713	713
Flow Rate (Actual Volumetric):	as found: 16.7	16.7	lpm	as left: 16.7	16.7
Flow Rate (EPA Standard):	as found:		lpm	as left:	

Mechanical Audits	
as found:	as left:
Pump muffler unclogged:	yes
Sample nozzle clean:	yes
Tape support vane clean:	yes
Capstan shaft clean:	yes
Rubber pinch rollers clean:	yes
Chassis Ground wire installed:	yes
PM 10 Particle trap clean:	yes
PM 10 drip jar empty:	yes
PM 10 bug screen clear:	yes
PM 2.5 particle trap clean:	yes
Inlet tube water tight seal OK:	yes
Inlet tube perpendicular to BAM:	yes

Flow Control Range	
Flow Set point (LPM)	BAM Flow (LPM)
15	15.0
16.7	16.7
18.4	18.4

Membrane Audit	
LAST m (mg):	0.828
ABS (mg):	0.827
Difference (mg):	-0.001
% Difference:	-0.12

Setup and Calibration Values								
Parameter	Expected	Found	Parameter	Expected	Found	Parameter	Expected	Found
Clock time/date	OK	OK	FLOW TYPE	Actual	Actual	AP	150	150
RS232	9600 8N1	9600 8N1	Cv	0.9	0.9	FR1	10	10
STATION #	2	2	Qo	-0.097	-0.097	FRH	20	20
RANGE (mg)	1.000	1.000	ABS	0.827	0.827	Password	F1 F2 F3 F4	F1 F2 F3 F4
BAM SAMPLE (min)	42	42	μsw:	0.303	0.303	Cycle Mode	Standard	Standard
MET SAMPLE (min)	60	60	K FACTOR	0.949	0.949	RH Control	Yes	Yes
OFFSET (mg)	-0.015	-0.015	BKGD	-0.0064	-0.0064	RH Set point (%)	35	35
CONC. UNITS	mg/m ³	mg/m ³	STD TEMP (C°)	25	25	Datalog RH (CH4)	Yes	Yes
COUNT TIME (min)	8	8	HEATER	Auto	Auto	Delta-T Control	No	No
FLOW RATE (LPM)	16.7	16.7	e1	-0.005	-0.005	Delta-T Set. (C°)	10	10
CONC. TYPE	Actual	Actual	Errors	none	none	Datalog D/T (CH5)	Yes	Yes

Last 6 Errors In BAM 1020 Error Log					
Error	Date	Time	Error	Date	Time
1 NONE			4		
2			5		
3			6		

Comments:

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ENSR

STATION 1
BAM 1020 Calibration Sheet

Model:	1020
S/N	G 4595
Audit Date:	3/4/2008

Audited By: BCJ

Flow Audits			
	Model	S/N	Cal Date:
Flow Reference Standard Used:	Bios DC-HC-1	1837	1/23/2008
Temperature Standard Used:	Techne 4400	304004	1/22/2008
Barometric Standard Used:	Meriam 350	949570	1/19/2007(exp7/19/08)

Leak Check Value (LPM): as found: 0.2 as left: 0.1

	BAM	Ref. Std.		BAM	Ref. Std.
Ambient Temperature:	as found: 0.6	0.4	C	as left: 0.4	0.4
Barometric Pressure:	as found: 701	701	mmHg	as left: 701	701
Flow Rate (Actual Volumetric):	as found: 16.7	16.7	lpm	as left: 16.7	16.7
Flow Rate (EPA Standard):	as found:		lpm	as left:	

Mechanical Audits	
as found:	as left:
Pump muffler unclogged:	yes
Sample nozzle clean:	yes
Tape support vane clean:	yes
Capstan shaft clean:	yes
Rubber pinch rollers clean:	yes
Chassis Ground wire installed:	yes
PM 10 Particle trap clean:	yes
PM 10 drip jar empty:	yes
PM 10 bug screen clear:	yes
PM 2.5 particle trap clean:	yes
Inlet tube water tight seal OK:	yes
Inlet tube perpendicular to BAM:	yes

Flow Set point (LPM)	BAM Flow (LPM)
15	15.0
16.7	16.7
18.4	18.4

Membrane Audit	
LAST m (mg):	0.8
ABS (mg):	0.796
Difference (mg):	-0.004
% Difference:	-0.50

Setup and Calibration Values								
Parameter	Expected	Found	Parameter	Expected	Found	Parameter	Expected	Found
Clock time/date	OK	OK	FLOW TYPE	Actual	Actual	AP	150	150
RS232	9600 8N1	9600 8N1	Cv	0.998	0.998	FR1	10	10
STATION #	1	1	Qo	0.000	0.000	FRH	20	20
RANGE (mg)	1.00	1.00	ABS	0.796	0.796	Password	F1 F2 F3 F4	F1 F2 F3 F4
BAM SAMPLE (min)	42	42	psw:	0.306	0.306	Cycle Mode	Standard	Standard
MET SAMPLE (min)	60	60	K FACTOR	0.956	0.956	RH Control	Yes	Yes
OFFSET (mg)	-0.015	-0.015	BKGD	-0.0032	-0.0032	RH Set point (%)	35	35
CONC. UNITS	mg/m3	mg/m3	STD TEMP (C°)	25	25	Datalog RH (CH4)	Yes	Yes
COUNT TIME (min)	8	8	HEATER	Auto	Auto	Delta-T Control	No	No
FLOW RATE (LPM)	16.7	16.7	e1	-0.005	-0.005	Delta-T Set. (C°)	10	10
CONC. TYPE	Actual	Actual	Errors	none	none	Datalog D/T (CH5)	Yes	Yes

Last 6 Errors In BAM 1020 Error Log					
Error	Date	Time	Error	Date	Time
1			4		
2			5		
3			6		

Comments:

ENSK

STATION 2
BAM 1020 Calibration Sheet

Model:	1020
S/N	G 4594
Audit Date:	3/4/2008

Audited By: BCJ

Flow Audits			
	Model	S/N	Cal Date:
Flow Reference Standard Used:	Bios DC-HC-1	1837	1/23/2008
Temperature Standard Used:	Techne 4400	304004	1/22/2008
Barometric Standard Used:	Meriam 350	949570	1/19/2007(exp7/19/08)

Leak Check Value (LPM): as found: 0.2 as left: 0.2

	BAM	Ref. Std.		BAM	Ref. Std.
Ambient Temperature:	as found: 0.4	0.4	C	as left: 0.4	0.4
Barometric Pressure:	as found: 707	707	mmHg	as left: 707	707
Flow Rate (Actual Volumetric):	as found: 16.7	16.7	lpm	as left: 16.7	16.7
Flow Rate (EPA Standard):	as found:		lpm	as left:	

Mechanical Audits		
	as found:	as left:
Pump muffler unclogged:	yes	yes
Sample nozzle clean:	yes	yes
Tape support vane clean:	yes	yes
Capstan shaft clean:	yes	yes
Rubber pinch rollers clean:	yes	yes
Chassis Ground wire installed:	yes	yes
PM 10 Particle trap clean:	yes	yes
PM 10 drip jar empty:	yes	yes
PM 10 bug screen clear:	yes	yes
PM 2.5 particle trap clean:	yes	yes
Inlet tube water tight seal OK:	yes	yes
Inlet tube perpendicular to BAM:	yes	yes

Flow Control Range	
Flow Set point (LPM)	BAM Flow (LPM)
15	15.0
16.7	16.7
18.4	18.4

Membrane Audit	
LAST m (mg):	0.828
ABS (mg):	0.827
Difference (mg):	-0.001
% Difference:	-0.12

Setup and Calibration Values								
Parameter	Expected	Found	Parameter	Expected	Found	Parameter	Expected	Found
Clock time/date	OK	OK	FLOW TYPE	Actual	Actual	AP	150	150
RS232	9600 8N1	9600 8N1	Cv	0.9	0.9	FR1	10	10
STATION #	2	2	Qo	-0.097	-0.097	FRH	20	20
RANGE (mg)	1.000	1.000	ABS	0.827	0.827	Password	F1 F2 F3 F4	F1 F2 F3 F4
BAM SAMPLE (min)	42	42	μsw:	0.303	0.303	Cycle Mode	Standard	Standard
MET SAMPLE (min)	60	60	K FACTOR	0.949	0.949	RH Control	Yes	Yes
OFFSET (mg)	-0.015	-0.015	BKGD	-0.0064	-0.0064	RH Set point (%)	35	35
CONC. UNITS	mg/m3	mg/m3	STD TEMP (C°)	25	25	Datalog RH (CH4)	Yes	Yes
COUNT TIME (min)	8	8	HEATER	Auto	Auto	Delta-T Control	No	No
FLOW RATE (LPM)	16.7	16.7	e1	-0.005	-0.005	Delta-T Set. (C°)	10	10
CONC. TYPE	Actual	Actual	Errors	none	none	Datalog D/T (CH5)	Yes	Yes

Last 6 Errors in BAM 1020 Error Log					
Error	Date	Time	Error	Date	Time
1 NONE			4		
2			5		
3			6		

Comments:

STATION 1
BAM 1020 Calibration Sheet

Model:	1020
S/N	G 4595
Audit Date:	4/24/2008

Audited By: BCJ

Flow Audits			
	Model	S/N	Cal Date:
Flow Reference Standard Used:	Bios DC-HC-1	1837	1/23/2008
Temperature Standard Used:	Techne 4400	304004	1/22/2008
Barometric Standard Used:	Meriam 350	949570	1/20/2008(exp7/19/08)

Leak Check Value (LPM): as found: 0.2 as left: 0.1

	BAM	Ref. Std.		BAM	Ref. Std.
Ambient Temperature:	as found: 4.6	4.2	C	as left: 4.2	4.2
Barometric Pressure:	as found: 702	702	mmHg	as left: 702	702
Flow Rate (Actual Volumetric):	as found: 16.4	16.7	lpm	as left: 16.7	16.7
Flow Rate (EPA Standard):	as found:		lpm	as left:	

Mechanical Audits		
Pump muffler unclogged:	as found: yes	as left: yes
Sample nozzle clean:	as found: yes	as left: yes
Tape support vane clean:	as found: yes	as left: yes
Capstan shaft clean:	as found: yes	as left: yes
Rubber pinch rollers clean:	as found: yes	as left: yes
Chassis Ground wire installed:	as found: yes	as left: yes
PM 10 Particle trap clean:	as found: yes	as left: yes
PM 10 drip jar empty:	as found: yes	as left: yes
PM 10 bug screen clean:	as found: yes	as left: yes
PM 2.5 particle trap clean:	as found: yes	as left: yes
Inlet tube water tight seal OK:	as found: yes	as left: yes
Inlet tube perpendicular to BAM:	as found: yes	as left: yes

Flow Control Range	
Flow Set point (LPM)	BAM Flow (LPM)
15	15.0
16.7	16.7
18.4	18.4

Membrane Audit	
LAST m (mg):	0.8
ABS (mg):	0.796
Difference (mg):	-0.004
% Difference:	-0.50

Setup and Calibration Values								
Parameter	Expected	Found	Parameter	Expected	Found	Parameter	Expected	Found
Clock time/date	OK	OK	FLOW TYPE	Actual	Actual	AP	150	150
RS232	9600 8N1	9600 8N1	Cv	0.998	0.998	FR1	10	10
STATION #	1	1	Qo	0.000	0.000	FRH	20	20
RANGE (mg)	1.00	1.00	ABS	0.796	0.796	Password	F1 F2 F3 F4	F1 F2 F3 F4
BAM SAMPLE (min)	42	42	μsw:	0.306	0.306	Cycle Mode	Standard	Standard
MET SAMPLE (min)	60	60	K FACTOR	0.956	0.956	RH Control	Yes	Yes
OFFSET (mg)	-0.015	-0.015	BKGD	-0.0032	-0.0032	RH Set point (%)	35	35
CONC. UNITS	mg/m ³	mg/m ³	STD TEMP (C°)	25	25	Datalog RH (CH4)	Yes	Yes
COUNT TIME (min)	8	8	HEATER	Auto	Auto	Delta-T Control	No	No
FLOW RATE (LPM)	16.7	16.7	e1	-0.005	-0.005	Delta-T Set. (C°)	10	10
CONC. TYPE	Actual	Actual	Errors	none	none	Datalog D/T (CH5)	Yes	Yes

Last 6 Errors in BAM 1020 Error Log					
Error	Date	Time	Error	Date	Time
1			4		
2			5		
3			6		

Comments:

STATION 2
BAM 1020 Calibration Sheet

Model:	1020
S/N	G 4594
Audit Date:	4/24/2008

Audited By: BCJ

Flow Audits			
	Model	S/N	Cal Date:
Flow Reference Standard Used:	Bios DC-HC-1	1837	1/23/2008
Temperature Standard Used:	Techne 4400	304004	1/22/2008
Barometric Standard Used:	Meriam 350	949570	1/20/2008(exp 7/19/08)

Leak Check Value (LPM): as found: 0.2 as left: 0.2

	BAM	Ref. Std.		BAM	Ref. Std.
Ambient Temperature:	as found: 3.8	3.8	C	as left: 3.8	3.8
Barometric Pressure:	as found: 702	702	mmHg	as left: 702	702
Flow Rate (Actual Volumetric):	as found: 16.7	16.7	lpm	as left: 16.7	16.7
Flow Rate (EPA Standard):	as found:		lpm	as left:	

Mechanical Audits	
as found:	as left:
Pump muffler unclogged:	yes
Sample nozzle clean:	yes
Tape support vane clean:	yes
Capstan shaft clean:	yes
Rubber pinch rollers clean:	yes
Chassis Ground wire installed:	yes
PM 10 Particle trap clean:	yes
PM 10 drip jar empty:	yes
PM 10 bug screen clear:	yes
PM 2.5 particle trap clean:	yes
Inlet tube water tight seal OK:	yes
Inlet tube perpendicular to BAM:	yes

Flow Control Range	
Flow Set point (LPM)	BAM Flow (LPM)
15	15.0
16.7	16.7
18.4	18.4

Membrane Audit	
LAST m (mg):	0.828
ABS (mg):	0.827
Difference (mg):	-0.001
% Difference:	-0.12

Setup and Calibration Values								
Parameter	Expected	Found	Parameter	Expected	Found	Parameter	Expected	Found
Clock time/date	OK	OK	FLOW TYPE	Actual	Actual	AP	150	150
RS232	9600 8N1	9600 8N1	Cv	0.9	0.9	FR1	10	10
STATION #	2	2	Qo	-0.097	-0.097	FRH	20	20
RANGE (mg)	1.000	1.000	ABS	0.827	0.827	Password	F1 F2 F3 F4	F1 F2 F3 F4
BAM SAMPLE (min)	42	42	psw:	0.303	0.303	Cycle Mode	Standard	Standard
MET SAMPLE (min)	60	60	K FACTOR	0.949	0.949	RH Control	Yes	Yes
OFFSET (mg)	-0.015	-0.015	BKGD	-0.0064	-0.0064	RH Set point (%)	35	35
CONC. UNITS	mg/m3	mg/m3	STD TEMP (C°)	25	25	Datalog RH (CH4)	Yes	Yes
COUNT TIME (min)	8	8	HEATER	Auto	Auto	Delta-T Control	No	No
FLOW RATE (LPM)	16.7	16.7	e1	-0.005	-0.005	Delta-T Set. (C°)	10	10
CONC. TYPE	Actual	Actual	Errors	none	none	Datalog D/T (CH5)	Yes	Yes

Last 6 Errors In BAM 1020 Error Log					
Error	Date	Time	Error	Date	Time
1	NONE		4		
2			5		
3			6		

Comments:

STATION 1
BAM 1020 Calibration Sheet

Model:	1020
S/N	G 4595
Audit Date:	7/23/2008

Audited By: BCJ

Flow Audits			
	Model	S/N	Cal Date:
Flow Reference Standard Used:	Bios DC-HC-1	1837	1/23/2008
Temperature Standard Used:	Techne 4400	304004	1/22/2008
Barometric Standard Used:	AIR - HB -2A	3C2430	2/9/2008

Leak Check Value (LPM): as found: 0.8 as left: 0.1

	BAM	Ref. Std.		BAM	Ref. Std.
Ambient Temperature:	as found: 22.3	22.1	C	as left: 22.1	22.1
Barometric Pressure:	as found: 705	705	mmHg	as left: 705	705
Flow Rate (Actual Volumetric):	as found: 16.5	16.7	lpm	as left: 16.7	16.7
Flow Rate (EPA Standard):	as found:		lpm	as left:	

Mechanical Audits		
Pump muffler unclogged:	as found: yes	as left: yes
Sample nozzle clean:	as found: yes	as left: yes
Tape support vane clean:	as found: yes	as left: yes
Capstan shaft clean:	as found: yes	as left: yes
Rubber pinch rollers clean:	as found: yes	as left: yes
Chassis Ground wire installed:	as found: yes	as left: yes
PM 10 Particle trap clean:	as found: yes	as left: yes
PM 10 drip jar empty:	as found: yes	as left: yes
PM 10 bug screen clear:	as found: yes	as left: yes
PM 2.5 particle trap clean:	as found: yes	as left: yes
Inlet tube water tight seal OK:	as found: yes	as left: yes
Inlet tube perpendicular to BAM:	as found: yes	as left: yes

Flow Control Range	
Flow Set point (LPM)	BAM Flow (LPM)
15	15.0
16.7	16.7
18.4	18.4

Membrane Audit	
LAST m (mg):	0.8
ABS (mg):	0.796
Difference (mg):	-0.004
% Difference:	-0.50

Setup and Calibration Values								
Parameter	Expected	Found	Parameter	Expected	Found	Parameter	Expected	Found
Clock time/date	OK	OK	FLOW TYPE	Actual	Actual	AP	150	150
RS232	9600 8N1	9600 8N1	Cv	0.998	0.998	FR1	10	10
STATION #	1	1	Qo	0.000	0.000	FRH	20	20
RANGE (mg)	1.00	1.00	ABS	0.796	0.796	Password	F1 F2 F3 F4	F1 F2 F3 F4
BAM SAMPLE (min)	42	42	hsw:	0.306	0.306	Cycle Mode	Standard	Standard
MET SAMPLE (min)	60	60	K FACTOR	0.956	0.956	RH Control	Yes	Yes
OFFSET (mg)	-0.015	-0.015	BKGD	-0.0032	-0.0032	RH Set point (%)	35	35
CONC. UNITS	mg/m3	mg/m3	STD TEMP (C°)	25	25	Datalog RH (CH4)	Yes	Yes
COUNT TIME (min)	8	8	HEATER	Auto	Auto	Delta-T Control	No	No
FLOW RATE (LPM)	16.7	16.7	e1	-0.005	-0.005	Delta-T Set. (C°)	10	10
CONC. TYPE	Actual	Actual	Errors	none	none	Datalog D/T (CH5)	Yes	Yes

Last 6 Errors in BAM 1020 Error Log					
Error	Date	Time	Error	Date	Time
1			4		
2			5		
3			6		

Comments:

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ENCR

STATION 2
BAM 1020 Calibration Sheet

Model:	1020
S/N	G 4594
Audit Date:	7/23/2008

Audited By: BCJ

Flow Audits			
	Model	S/N	Cal Date:
Flow Reference Standard Used:	Bios DC-HC-1	1837	1/23/2008
Temperature Standard Used:	Techne 4400	304004	1/22/2008
Barometric Standard Used:	AIR - HB -2A	3C2430	2/9/2008

Leak Check Value (LPM): as found: 0.5 as left: 0.2

	BAM	Ref. Std.		BAM	Ref. Std.
Ambient Temperature:	as found: 21.1	20.8	C	as left: 20.8	20.8
Barometric Pressure:	as found: 705	705	mmHg	as left: 705	705
Flow Rate (Actual Volumetric):	as found: 16.6	16.7	lpm	as left: 16.7	16.7
Flow Rate (EPA Standard):	as found:		lpm	as left:	

Mechanical Audits	
as found:	as left:
Pump muffler unclogged:	yes
Sample nozzle clean:	yes
Tape support vane clean:	yes
Capstan shaft clean:	yes
Rubber pinch rollers clean:	yes
Chassis Ground wire installed:	yes
PM 10 Particle trap clean:	yes
PM 10 drip jar empty:	yes
PM 10 bug screen clear:	yes
PM 2.5 particle trap clean:	yes
Inlet tube water tight seal OK:	yes
Inlet tube perpendicular to BAM:	yes

Flow Control Range	
Flow Set point (LPM)	BAM Flow (LPM)
15	15.0
16.7	16.7
18.4	18.4

Membrane Audit	
LAST m (mg):	0.828
ABS (mg):	0.827
Difference (mg):	-0.001
% Difference:	-0.12

Setup and Calibration Values								
Parameter	Expected	Found	Parameter	Expected	Found	Parameter	Expected	Found
Clock time/date	OK	OK	FLOW TYPE	Actual	Actual	AP	150	150
RS232	9600 8N1	9600 8N1	Cv	0.9	0.9	FR1	10	10
STATION #	2	2	Qo	-0.097	-0.097	FRH	20	20
RANGE (mg)	1.000	1.000	ABS	0.827	0.827	Password	F1 F2 F3 F4	F1 F2 F3 F4
BAM SAMPLE (min)	42	42	μsw:	0.303	0.303	Cycle Mode	Standard	Standard
MET SAMPLE (min)	60	60	K FACTOR	0.949	0.949	RH Control	Yes	Yes
OFFSET (mg)	-0.015	-0.015	BKGD	-0.0064	-0.0064	RH Set point (%)	35	35
CONC. UNITS	mg/m3	mg/m3	STD TEMP (C°)	25	25	Datalog RH (CH4)	Yes	Yes
COUNT TIME (min)	8	8	HEATER	Auto	Auto	Delta-T Control	No	No
FLOW RATE (LPM)	16.7	16.7	e1	-0.005	-0.005	Delta-T Set. (C°)	10	10
CONC. TYPE	Actual	Actual	Errors	none	none	Datalog D/T (CH5)	Yes	Yes

Last 6 Errors in BAM 1020 Error Log					
Error	Date	Time	Error	Date	Time
1	NONE		4		
2			5		
3			6		

Comments:

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Met One Instruments
1600 Washington Blvd
Grants Pass, OR. 97526
(541) 471-7111

Certificate of Calibration

Model BAM-1020
EPA DESIGNATION NUMBER – EPQM-0798-122

Calibration traceable to the National Institute of Standards and Technology in accordance with MIL-STD-45662A has been accomplished on the instrument by comparison standards maintained by Met One Instruments. Complete record of all work performed is maintained by Met One Instruments and is available for inspection upon request.

Unit Serial Number G4595 Date 6-19-2007

Calibration Performed by Will Ossad

Standards Used:

Flow Calibration, BIOS B3432 Calibration Date 08/18/04

Electronic Calibration, FLUKE 189 Calibration Date 11/03/06

Gravimetric Calibration, SIBATA BAM-102 Calibration Date 8/94

BAM 1020-9600

Met One Instruments
1600 Washington Blvd
Grants Pass, OR. 97526
(541) 471-7111

Certificate of Calibration

Model BAM-1020
EPA DESIGNATION NUMBER – EPQM-0798-122

Calibration traceable to the National Institute of Standards and Technology in accordance with MIL-STD-45662A has been accomplished on the instrument by comparison standards maintained by Met One Instruments. Complete record of all work performed is maintained by Met One Instruments and is available for inspection upon request.

Unit Serial Number G4594 Date 6-20-2007

Calibration Performed by Willie D. D.

Standards Used:

Flow Calibration, BIOS B3432 Calibration Date 08/18/04

Electronic Calibration, FLUKE 189 Calibration Date 11/03/06

Gravimetric Calibration, SIBATA BAM-102 Calibration Date 8/94

BAM 1020-9600

Met One Instruments
1600 Washington Blvd
Grants Pass, OR. 97526
(541) 471-7111

Certificate of Calibration

Model BAM-1020
EPA DESIGNATION NUMBER – EPQM-0798-122

Calibration traceable to the National Institute of Standards and Technology in accordance with MIL-STD-45662A has been accomplished on the instrument by comparison standards maintained by Met One Instruments. Complete record of all work performed is maintained by Met One Instruments and is available for inspection upon request.

Unit Serial Number G4595 Date 8-22-2007

Calibration Performed by Jill Olds

Standards Used:

Flow Calibration, BIOS B3432 Calibration Date 08/18/04

Electronic Calibration, FLUKE 189 Calibration Date 11/03/06

Gravimetric Calibration, SIBATA BAM-102 Calibration Date 8/94

BAM 1020-9600

Bios International Calibration Certificate

Report No. 54646
Product DC-HC-1
Serial No. 1837
Cal. Date 15 January 2007
Annual Maint. Recommended

ENSR Corporation
1601 Prospect Parkway
Fort Collins CO 80525
Acct. No. ENSFOR-2
PO No.



As Received Test Data

Calibration Standards Used

All units tested in accordance with Bios International Corporation test number PR05-2 Rev B or PR01-10 Rev D using high-purity bottled nitrogen.

Asset Number	Description	Cal Date	Due Date
ML-500-44 102677	ML-500 High Flow Cell	10/12/2006	10/12/2007

Technician Zenaida Ortiz
Lab. Temperature 22.2 °C

Instrument Reading (ml/min)	Lab Standard Reading (ml/min)	Lab Standard Unit No.	Deviation	Allowable Deviation	Condition Shipped
502.2	500.25	100114	0.39 %	1.00%	in tolerance
4994	5004	102677	-0.20%	1.00%	in tolerance
49330	49055	102677	0.56 %	1.50%	in tolerance

The allowable deviation consists of the RSS of the expanded uncertainties of the working standards (0.25%), experimental errors (0.25%), and the error of the device under test (DUT), which is the remainder of the allowable deviation.

As Shipped Test Data

Calibration Standards Used

All units tested in accordance with Bios International Corporation test number PR05-2 Rev B or PR01-10 Rev D using high-purity bottled nitrogen.

Asset Number	Description	Cal Date	Due Date
ML-500-44 102677	ML-500 High Flow Cell	10/12/2006	10/12/2007

Technician Zenaida Ortiz
Lab. Temperature 22.2 °C

Instrument Reading (ml/min)	Lab Standard Reading (ml/min)	Lab Standard Unit No.	Deviation	Allowable Deviation	Condition Shipped
502.1	500.55	100114	0.31 %	1.00%	in tolerance
4999	5006.5	102677	-0.15%	1.00%	in tolerance
49350	49035	102677	0.64 %	1.50%	in tolerance

The allowable deviation consists of the RSS of the expanded uncertainties of the working standards (0.25%), experimental errors (0.25%), and the error of the device under test (DUT), which is the remainder of the allowable deviation.

Each DryCal flow calibrator is dynamically tested by comparing it to a laboratory standard primary piston prover of much higher accuracy ($\pm 0.25\%$ or better) but of similar operating principles. Flow generators of $\pm 0.03\%$ stability are used for the comparison. Use of provers of similar construction to the device under test assures the validity of the flow generator as a transfer standard. The primary laboratory standards are qualified by direct measurement of their dimensions (diameter, length of measured path, time base) against NIST traceable gauges and instruments (NIST numbers available upon request). A rigorous analysis of their accuracy in accordance with the International Guide to Uncertainty in Measurements has been performed, assuring their traceable accuracy. Test procedures ensure temperature matching of the laboratory standards and the device under test.

Harvey Padden, President

Bios International Corporation
10 Park Place, Butler, NJ 07405 USA
www.biosint.com

Printed 15 January 2007

Bios International Calibration Certificate

Report No. 65434
Product DC-HC-1
Serial No. 1837
Cal. Date 23 January 2008
Annual Maint. Recommended

**ENSR Corporation
1601 Prospect Parkway
Fort Collins CO 80525
Acct. No. ENSFOR-2
PO No.**



As Received Test Data

Calibration Standards Used

All units tested in accordance with Bios International Corporation test number PR05-2 Rev B or PR01-10 Rev D using high-purity bottled nitrogen.

Asset Number	Description	Cal Date	Due Date
ML-500-24 110409	ML-500 Medium Flow Cell	5/4/2007	5/4/2008
ML-500-44 102677	ML-500 High Flow Cell	10/22/2007	10/22/2008

Technician Zenaida Ortiz **Lab. Pressure** 756.19 mmHg
Lab. Temperature 22.2 °C

Instrument Reading (ml/min)	Lab Standard Reading (ml/min)	Lab Standard Unit No.	Deviation	Allowable Deviation	Condition Shipped
501.9	500.14	110409	0.35 %	1.00%	In tolerance
4998	5007.05	102677	-0.18%	1.00%	In tolerance
49140	49003.5	102677	0.28 %	1.50%	In tolerance

The allowable deviation consists of the RSS of the expanded uncertainties of the working standards (0.26%), experimental errors (0.26%), and the error of the device under test (DUT), which is the remainder of the allowable deviation.

As Shipped Test Data

Calibration Standards Used

All units tested in accordance with Bios International Corporation test number PR05-2 Rev B or PR01-10 Rev D using high-purity bottled nitrogen.

Asset Number	Description	Cal Date	Due Date
ML-500-24 110409	ML-500 Medium Flow Cell	5/4/2007	5/4/2008
ML-500-44 102677	ML-500 High Flow Cell	10/22/2007	10/22/2008

Technician Zenaida Ortiz **Lab. Pressure** 757.51 mmHg
Lab. Temperature 22.6 °C

Instrument Reading (ml/min)	Lab Standard Reading (ml/min)	Lab Standard Unit No.	Deviation	Allowable Deviation	Condition Shipped
501.9	500.275	110409	0.32 %	1.00%	in tolerance
5004	5009.05	102677	-0.10%	1.00%	in tolerance
49320	49032	102677	0.59 %	1.50%	In tolerance

The allowable deviation consists of the RSS of the expanded uncertainties of the working standards (0.25%), experimental errors (0.25%), and the error of the device under test (DUT), which is the remainder of the allowable deviation.

Each DryCal flow calibrator is dynamically tested by comparing it to a laboratory standard primary piston prover of much higher accuracy ($\pm 0.25\%$ or better) but of similar operating principles. Flow generators of $\pm 0.03\%$ stability are used for the comparison. Use of provers of similar construction to the device under test assures the validity of the flow generator as a transfer standard. The primary laboratory standards are qualified by direct measurement of their dimensions (diameter, length of measured path, time base) against NIST traceable gauges and instruments (NIST numbers available upon request). A rigorous analysis of their accuracy in accordance with the International Guide to Uncertainty in Measurements has been performed, assuring their traceable accuracy. Test procedures ensure temperature matching of the laboratory standards and the device under test.

Bios International Corporation
10 Park Place, Butler, NJ 07405 USA
www.biosint.com

Printed 23 January 2008

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Certificate of Calibration

The instrument below has been presented for inspection and test as shown.
The indicated work was performed using equipment that is calibrated and
traceable to the National Institute of Standards and Technology.

Model Number: 4400 Thermometer w/SP646

Serial Number: 304004

Customer: ENSR

Address: 1601 Prospect Parkway
Fort Collins, CO 80525-9769

Email: hsofai@ensr.com

Certificate Nbr: 18452

Cal Date: 1/10/2007

PO Number: 9963

Due Date: 1/10/2008

Calibration Data:

Standard Reading	UUT As Received	UUT As Left
-15.03°C	-14.99	-14.99
39.87°C	39.86	39.86
89.94°C	89.92	89.92
124.99°C	124.98	124.98

Meets or exceed the required accuracy of +/- 0.05 for this model.

Test ambient = 23 +/- 5.0 deg.C Humidity % = 25

Test Procedure 10103

Our calibrations are performed in compliance with the requirements of ISO9000:2000, Mil-Std-45662A and ANSI/NCSL Z540-1994 as applicable. Unless specified otherwise, this calibration meets the 4:1 accuracy ratio as outlined in these requirements. The results in this report relate only to the item being calibrated. This calibration certificate and attached data shall not be reproduced without the written approval of Techne Inc.

Measurement and Test Equipment:

Asset Nbr:	Model Nbr:	Manufacturer:	Cal Date:	Cal Due Date:
1008	ASL-F-250 PRT indicator	Instrulab	12/7/2006	3/7/2006
1011	12001-PRT	Burns	9/29/2006	3/29/2007

Calibrated by: Daren Jaeger

Verified by: Christian Dyrud

Comments:

Techne Incorporated

3 Terri Lane, Suite 10
Burlington, NJ 08016
Telephone: 800-225-9243
Fax: 609-589-2571
www.techne.com

CERTIFICATE OF CALIBRATION

The instrument below has been presented for inspection and test as shown. The indicated work was performed using reference standards that are traceable to the National Institute of Standards and Technology. We employ industry accepted methods, those issued by recognized organizations (ASTM) or by known intrinsic standards for calibration of the device listed.

Model Number: 4400 Thermometer w/SP646 Cal Date: 1/22/2008
Serial Number: 304004 Due Date: 1/22/2009
Certificate Nbr: 20011 Asset Tag ID:
Customer: ENSR
Address: 1601 Prospect Parkway PO Number: 2058009
Fort Collins, CO 80525-9769

Calibration Data:

<u>Standard Reading</u>	<u>UUT As Received</u>	<u>UUT As Left</u>
-15.208°C	-15.19	-15.19
39.995°C	40.00	40.00
89.988°C	89.97	89.97
125.031°C	125.01	125.01

These results meet or exceed the specified accuracy of +/- 0.05°C for this model.

Calibration procedure: 30109 Test ambient: 23 +/- 3.0 deg. Humidity %: 16

Our calibrations are performed in compliance with the requirements of ISO9000:2000 and ANSI/NCSL Z540-1994.

We adhere to the following ASTM standards where applicable, E220-07, E563-02, E1137-04, and E644-06. Information contained in NIST technical note 1265, "Guidelines for realizing the International Temperature of 1990 (ITS90)" is used for PRT calibrations. This calibration certificate and attached data shall not be reproduced without the written approval of Techne Inc. These results relate only to the item calibrated or tested whereby the accuracy is based on the manufacturers published specifications.

Measurement and Test Equipment:

Asset Nbr:	Model Nbr:	Manufacturer:	Cal Date:	Cal Due Date:
1052	Tecal Accutemp indicator	Techne	11/2/2007	2/2/2008
1057	832 PRT	Instrulab	1/15/2008	7/15/2008

Measurement Uncertainty (K=2): as related to the procedure listed above.

Measurement	-20 to 200°C	-40.0°C	-80.0°C	1200.0°C	232.0°C	420.0°C	660.0°C
Uncertainty	± 0.048	± 0.041	± 0.042	± 4.701	± 0.045	± 0.062	± 0.088

Calibrated by: Daren J. Lauer

Verified by: Daren J. Lauer

Comments:



Techne Incorporated
3 Terri Lane, Suite 10
Burlington, NJ 08016
Telephone: 800-225-9243
Fax: 609-589-2571
www.techneusa.com



meriam
process technologies

a Scott Fetzer company

A36637- 20 - 11

E.O. 5706

Date of Issue: 1/20/2007

**Certificate of Calibration
Precision Absolute Manometer 355 (.02%)**

Certification Date: 1/19/2007

Model Number/Range: 355-AI0900 / 0-900 MMHGA

Recertification Date: 7/19/2008

Serial Number: 949570-A1

Sensor I.D. AI92YL29.83

The Meriam Instrument Company hereby certifies the accuracy of the above listed instrument to be $\pm 0.02\%$ of F.S. [includes combined effects of linearity, repeatability, hysteresis and temperature]. This accuracy was verified in accordance with Meriam Instrument procedure A35924 and is traceable to the National Institute of Standards and Technology through the below listed laboratory standards.

Standard #1: C-85 Piston/Mass Set 38342

Standard #2: N/A

Standard #3: N/A

Standard #4: N/A

Standard #5: N/A

Standard #6: N/A

Room Ambient Conditions: Temperature: $22^\circ\text{C} \pm 3^\circ\text{C}$ Relative Humidity: 10% - 55% RH

As Received Condition

In Tolerance

Out of Tolerance

Inoperative

N/A

As Left Condition

In Tolerance

Out of Tolerance

Inoperative

Comments:

There are no special limitations of use imposed on this item due to calibration. We suggest the instrument be evaluated (Recertification Date), however, your particular quality system requirements may supersede this date.

This Certificate of Calibration is provided as support documentation for the customer and may not be reproduced, except in full, without written permission of the issuing organization.

The standards and calibration program are based on the guidelines of ANSI/NCSL Z540-1-1994 and ISO 17025.

Issued By: Jim Poorman *(Signature)*

Page 1 of 1

Date: <u>1/17/2007</u>	Barometric Pressure Manufacturer: <u>AIR</u>	SN: <u>3C2430</u>
	Barometric Pressure Model: <u>HB-2A</u>	
Reference Barometer: <u>Nova Mercurial Barometer</u>	Model: <u>469</u>	SN: <u>N/A</u>
Reference Barometer Manufacturer: <u>Princo Instruments</u>		

Pressure Verification Results (compared to Ambient conditions)

Audit/Calibration Point	Reference Pressure	U.U.T. Pressure Reading (mmHg)	Error ¹	Accuracy
1	633.9	634.8	0.9	± 2.3 mmHg
2	633.3	634.4	1.1	± 2.3 mmHg
3	633.6	634.1	0.5	± 2.3 mmHg
4	633.1	633.9	0.8	± 2.3 mmHg
5	632.0	632.7	0.7	± 2.3 mmHg
6	631.8	632.8	1.0	± 2.3 mmHg
7	631.7	632.8	1.1	± 2.3 mmHg
8	632.0	632.9	0.9	± 2.3 mmHg
9	631.7	632.7	1.0	± 2.3 mmHg
10	632.1	633.1	1.0	± 2.3 mmHg
Average	632.5	633.4	0.9	± 2.3 mmHg

¹ Error; U.U.T. pressure compared to Reference pressure

Remarks

Reference Pressure corrected for temperature and gravity using the following multiplier:

$$(\text{Corrected Pressure}) = 0.995959 \times (\text{Observed Reference Barometer Reading})$$

Signature

Instrument IdentificationCompany ID: 85038
ENSR1601 PROSPECT PARKWAY
FORT COLLINS, CO, 80525Instrument ID: 3C2430
Manufacturer: ATMOSPHERIC INSTRUMENTATION RESEA
Description: BAROMETER/ALTIMETER
Accuracy: ± 0.5 mm Hg

PO Number: 0084-09963

Model Number: AIR-HB-2A
Serial Number: 3C2430**Certificate Information**Reason For Service: CALIBRATION
Type of Cal: NORMAL
As Found Condition: IN TOLERANCE
As Left Condition: LEFT AS FOUND
Procedure: 33K6-4-473-1 BAROMETER

Remarks:Technician: JOZEF SEDLACEK
Cal Date: 09Feb2008
Cal Due Date: 09Feb2009
Interval: 12 MONTHS
Temperature: 22.0 C
Humidity: 35.0 %*The instrument on this certification has been calibrated against standards traceable to the National Institute of Standards and Technology (NIST) or other recognized national metrology institutes, derived from ratio type measurements, or compared to nationally or internationally recognized consensus standards.**A test uncertainty ratio (T.U.R.) of 4:1 [K=2, approx. 95% Confidence Level] was maintained unless otherwise stated.**Davis Inotek Instruments Calibration Laboratory is certified to ISO 9001:2000 by Eagle Registrations (certificate # 3046). Lab Operations meet the requirements of ANSI/NCSL Z540-1-1994, ISO 10012, 10CFR50 AppxB, and 10CFR21.**ISO/IEC 17025-2005 accredited calibrations are per ACCLASS certificate # AC-1121 within the scope for which the lab is accredited.
All results contained within this certification relate only to item(s) calibrated. Any number of factors may cause the calibration item to drift out of calibration before the instrument's calibration interval has expired.**This certificate shall not be reproduced except in full, without written consent of Davis Calibration Laboratory.*Approved By: JOZEF SEDLACEK
Service Representative**Calibration Standards**

NIST Traceable#	Inst. ID#	Description	Model	Cal Date	Date Due
1555182	01-0061	DIRECT READING PRESSURE GAUGE	6000-151-00	05Oct2007	05Oct2008

U.S. Locations

AK, Anchorage (907) 561-5700	MA, Westford (978) 589-3000	SC, Columbia (803) 216-0003
AL, Birmingham (205) 980-0054	MA, Woods Hole (508) 457-7900	TX, Dallas (972) 509-2250
AL, Florence (256) 767-1210	MD, Columbia (410) 884-9280	TX, Houston (713) 520-9900
CA, Alameda (510) 748-6700	ME, Portland (207) 773-9501	TX, San Antonio (210) 296-2125
CA, Camarillo (805) 388-3775	MI, Detroit (269) 385-4245	VA, Chesapeake (757) 312-0063
CA, Orange (714) 973-9740	MN, Minneapolis (952) 924-0117	VA, Glen Allen (804) 290-7920
CA, Sacramento (916) 362-7100	NC, Charlotte (704) 529-1755	WA, Redmond (425) 881-7700
CO, Ft. Collins (970) 493-8878	NC, Raleigh (919) 872-6600	WI, Milwaukee (262) 523-2040
CO, Ft. Collins Tox Lab. (970) 416-0916	NH, Belmont (603) 524-8866	Headquarters MA, Westford (978) 589-3000
CT, Stamford (203) 323-6620	NJ, Piscataway (732) 981-0200	Worldwide Locations
CT, Willington (860) 429-5323	NV, Henderson (702) 966-8410	Bolivia
FL, St. Petersburg (727) 577-5430	NY, Albany (518) 453-6444	Brazil
FL, Tallahassee (850) 385-5006	NY, Rochester (585) 381-2210	China
GA, Norcross (770) 381-1836	NY, Syracuse (315) 432-0506	England
IL, Chicago (630) 836-1700	NY, Syracuse Air Lab. (315) 432-0506	France
IL, Collinsville (618) 344-1545	OH, Cincinnati (513) 772-7800	Italy
LA, New Orleans (504) 592-3559	PA, Langhorne (215) 757-4900	Japan
MA, Harvard Air Lab. (978) 772-2345	PA, Pittsburgh (412) 261-2910	Malaysia
MA, Sagamore Beach (508) 888-3900	RI, Providence (401) 274-5685	Philippines
		Singapore
		Thailand
		Turkey
		Venezuela
		www.ensr.aecom.com

About ENSR

ENSR, an AECOM company, is a leading worldwide environmental services firm. Founded in 1968, ENSR serves industrial companies and government agencies with consulting, engineering, remediation, and environmental health and safety solutions. ENSR is a recipient of the BP HSSE Diamond Award, Textron Environmental Remediation Partner in Excellence Award, and Environmental Business Journal awards. As an AECOM company, ENSR is part of a global design and management company with 29,000 employees worldwide serving the transportation, facilities, and environmental markets.

ENSR Locations

Alabama	Bolivia
Alaska	Brazil
California	China
Colorado	England
Connecticut	France
Florida	Italy
Georgia	Japan
Illinois	Malaysia
Louisiana	Philippines
Maine	Singapore
Maryland	Thailand
Massachusetts	Turkey
Michigan	Venezuela
Minnesota	
Nevada	

New Hampshire	Headquarters
New Jersey	Westford
New York	Massachusetts
North Carolina	USA
Ohio	
Pennsylvania	
Rhode Island	
South Carolina	
Texas	
Virginia	
Washington	
Wisconsin	